BROOKHAVEN NATIONAL LABORATORY

Work Permit # DRL-2010-6
Work Order # _____
Job# _____ Activity# _____

1. Work requester fills out this section. ☐ **Standing Work Permit**

Requester: Don Lynch	Date: 06/04/2010	Ext.: 2253	Dept/Div/Group: PO/PHENIX
Other Contact person (if different from requester): Carter Biggs			Ext.: 7515
Work Control Coordinator: Don Lynch		Start Date: 06/09/2010	Est. End Date: 12/1/2010
Brief Description of Work: Install RPC3 S Detector subsystem array			
Building: 1008	Room: IR & Tunnel North of IR	Equipment: RPC3 S	Service Provider: PHENIX techs & RPC experts, riggers,carpenters, electricians, masons, CAD Techs

. WCC, Requester/Designee, Service Provider, and ES&H (as necessary) fill out this section or attach analysis

ES&H ANALYSIS				
Radiation Concerns	☒ None	☐ Activation	☐ Airborne	☐ Contamination	☒ Radiation
Radiation Generating Devices:	☐ Radiography	☐ Moisture Density Gauges	☐ Soil Density Gauges	☐ X-ray Equipment
☐ Special nuclear materials involved, notify Isotope Special Materials Group			☐ Fissionable materials involved, notify Laboratory Criticality Officer	
Safety Concerns	☐ None	☐ Ergonomics	☐ Transport of Haz/Rad Material	
☐ Adding/Removing Walls or Roofs	☒ Confined Space*	☐ Explosives	☐ Lead*	☐ Penetrating Fire Walls
	☐ Corrosive	☐ Flammable	☐ Magnetic Field*	☐ Pressurized Systems
☐ Asbestos*	☐ Cryogenic	☐ Fumes/Mist/Dust*	☐ Material Handling	☐ Rigging/Critical Lift
☐ Beryllium*	☐ Electrical	☐ Heat/Cold Stress	☐ Noise*	☐ Toxic Materials*
☐ Biohazard*	☒ Elevated Work*	☐ Hydraulic	☐ Non-ionizing Radiation*	☐ Vacuum
☐ Chemicals*	☐ Excavation	☐ Lasers*	☐ Oxygen Deficiency*	☐ Other
* Does this work require medical clearance or surveillance from the Occupational Medicine Clinic? ☐ Yes ☒ No				
Environmental Concerns		☒ None	☐ Work impacts Environmental Permit No.	
☐ Atmospheric Discharges (rad/non-rad)		☐ Land Use	☐ Soil Activation/contamination	☐ Waste-Mixed
☐ Chemical or Rad Material Storage or Use		☐ Liquid Discharges	☐ Waste-Clean	☐ Waste-Radioactive
☐ Cesspools (UIC)		☐ Oil/PCB Management	☐ Waste-Hazardous	☐ Waste-Regulated Medical
☐ High water/power consumption		☐ Spill potential	☐ Waste-Industrial	☐ Underground Duct/Piping
Waste disposition by:				☐ Other
Pollution Prevention (P2)/Waste Minimization Opportunity:		☒ None ☐ Yes		
FACILITY CONCERNS	☒ None			
☐ Access/Egress Limitations	☐ Electrical Noise	☐ Potential to Cause a False Alarm		☐ Vibrations
	☐ Impacts Facility Use Agreement		☐ Temperature Change	☐ Other
☐ Configuration Control	☐ Maintenance Work on Ventilation Systems		☐ Utility Interruptions	
WORK CONTROLS				
Work Practices				
☐ None	☐ Exhaust Ventilation	☒ Lockout/Tagout	☐ Spill Containment	☐ Security (see Instruction Sheet)
☒ Back-up Person/Watch	☐ HP Coverage	☐ Posting/Warning Signs	☐ Time Limitation	☐ Other
☐ Barricades	☐ IH Survey	☐ Scaffolding-requires inspection	☐ Warning Alarm (i.e. “high level”)	
Protective Equipment				
☐ None	☐ Ear Plugs	☐ Gloves	☐ Lab Coat	☒ Safety Glasses
☐ Coveralls	☐ Ear Muffs	☐ Goggles	☐ Respirator	☒ Safety Harness
☐ Disposable Clothing	☐ Face Shield	☒ Hard Hat	☐ Shoe Covers	☒ Safety Shoes ☐ Other
Permits Required (Permits must be valid when job is scheduled.)				
☒ None	☐ Cutting/Welding	☐ Impair Fire Protection Systems		
☐ Concrete/Masonry Penetration	☐ Digging/Core Drilling	☐ Rad Work Permit-RWP No		
☐ Confined Space Entry	☐ Electrical Working Hot	☐ Other		
Dosimetry/Monitoring				
☐ None	☐ Heat Stress Monitor	☐ Real Time Monitor	☒ TLD	
☐ Air Effluent	☐ Noise Survey/Dosimeter	☐ Self-reading Pencil Dosimeter	☐ Waste Characterization	
☐ Ground Water	☐ O_2/Combustible Gas	☐ Self-reading Digital Dosimeter	☐ Other Check O2 level prior to entry	
☐ Liquid Effluent	☐ Passive Vapor Monitor	☐ Sorbent Tube/Filter Pump		
Training Requirements (List below specific training requirements)				
Confined Space, CA –Collider User, PHENIX Awareness, Working at heights, confined space				
Based on analysis above, the Walkdown Team determines the risk, complexity, and coordination ratings below:			**If using the permit when all hazard ratings are low, only the following need to sign: (Although allowed, there is no need to use back of form)**	
ES&H Risk Level:	☐ Low ☒ Moderate ☐ High		WCC:	Date:
Complexity Level:	☐ Low ☒ Moderate ☐ High		Service Provider:	Date:
Work Coordination:	☐ Low ☒ Moderate ☐ High		Authorization to start	Date:
			(Departmental Sup/WCC/Designee)	

3. Both work requester and service provider contribute to work plan (use attachments for detailed plans)

Work Plan (procedures, timing, equipment, and personnel availability need to be addressed): This project has been extensively reviewed with all service providers to assure optimum coordination in schedule and responsibilities. A detailed installation plan has been created and reviewed. A copy is attached.
Special Working Conditions Required: None
Operational Limits Imposed: Modification work limited to lower octants easily reachable when standing on lower magnet superstructure.
Post Work Testing Required: No

Job Safety Analysis Required: ☐ Yes ☒ No	Walkdown Required: ☒ Yes ☐ No

Reviewed by: Primary Reviewer will determine the size of the review team and the other signatures required based on hazards and job complexity. Primary Reviewer signature means that the hazards and risks that could impact ES&H have been identified and will be controlled according to BNL requirements.

Title	Name (print)	Signature	Life #	Date
Primary Reviewer				
ES&H Professional				
Other				
Other				
Work Control Coordinator				
Service Provider				
	Review Done: ☐ in series	☐ team		

4. Job site personnel fill out this section.

Note: Signature indicates personnel performing work have read and understand the hazards and permit requirements (including any attachments).			
Job Supervisor:		Contractor Supervisor:	
Workers:	Life#:	Workers :	Life#:
Workers are encouraged to provide feedback on ES&H concerns or on ideas for improved job work flow. Use feedback form or space below.			

5. Departmental Job Supervisor, Work Control Coordinator/Designee

Conditions are appropriate to start work: (Permit has been reviewed, work controls are in place and site is ready for job.)			
Name:	Signature:	Life#:	Date:

6. Departmental Job Supervisor, Work Requester/Designee determines if Post Job Review is required. ☐ Yes ☐ No

Post Job Review (Fill in names of reviewers)			
Name:	Signature:	Life#:	Date:
Name:	Signature:	Life#:	Date:

7. Worker provides feedback.

Worker Feedback (use attached sheets as necessary)
a) WCM/WCC: Is any feedback required? ☐ Yes ☐ No

b) Workers: Are there better methods or safer ways to perform this job in the future? ☐ Yes ☐ No

8. Closeout: Work Control Coordinator (authorizing dept.) checks quality of completed permit and ensures the work site is left in an acceptable condition. (WCC can delegate clean up of work area to work supervisor)

Name:	Signature:	Life#:	Date:
Comments:			

Attachment to W.P. # June 4, 2010,

Installation of the RPC3 Detector Subsystem in the PHENIX South Tunnel

Introduction

In the 2010 shutdown, the PHENIX experiment plans to install the second station of the new RPC detector subassembly. This detector will be an integral part of a new fast muon trigger for the PHENIX experiment that will enable the study of flavor separated quark and anti-quark spin polarizations in the proton. A powerful way of measuring these polarizations is via single spin asymmetries for W boson production in polarized proton-proton reactions. The measurement is done by tagging W+ and W− via their decay into high transverse momentum leptons in the forward directions. The PHENIX experiment is capable of measuring high momentum muons at forward rapidity, but the current online trigger does not have sufficient rejection to sample the rare leptons from W decay at the highest luminosities at the Relativistic Heavy Ion Collider (RHIC). Installation of the South station 3 component of the RPC detector subsystem, in conjunction with the installation of the Muon Trigger FEE stations 1, 2 and 3 which was completed last year, will be a major milestone in the overall project.

The installation of RPC station 3 south is accomplished by installing each of 16 half-octants of the full detector station which surrounds the RHIC accelerator beam axis in a 360º coverage. Each half-octant is a 4 sided truncated wedge/pie shape approximately 12 feet long, approximately 2 feet wide at the narrow end and approximately 7 feet wide at the outer end. The maximum thickness of the half octant is 4.76 inches. The half octants will weigh a maximum of 750lbs each.

Installation of the half octants is accomplished using a detailed procedure, described herein, involving the use of a portable crane and 2 custom designed lifting assemblies, each of which has 3 different lifting points to be used to lift and orient the half octants into their installed positions. The design calculations for the lifting fixtures are documented in PHENIX analysis document DRL-ECD-2009-008, wherein the design calculations to demonstrate the structural integrity of both of these lifting fixtures under the design conditions is described.

All of the techniques and tools to be used in the installation of the RPC3 South detector subassembly have been tried and proven effective in the installation of the RPC3 North detector subassembly in 2009. The South subassembly is essentially the mirror image of the North subassembly with respect to the PHENIX IP.

The procedure by which this installation will be accomplished is provided below. An Illustrated installation plan, which has been reviewed by CAD ESRC personnel and CAD engineers is attached.

Work Plan

This work is to be done by fully trained and experienced personnel (PHENIX and CAD mechanical and electrical technicians, BNL riggers, BNL Masons and BNL electricians during the 2010 summer shutdown.

(Please see the RPC3 South Illustrated installation plan which accompanies this Work Permit for more detailed descriptions of each of the following steps.)

1. Preparation for Installation

a) Gap evaluation/Cleaning Review with Masons for grouting

PHENIX engineers and technicians shall meet with BNL Masons to evaluate the task of pouring grout into gap 5 to achieve maximal structural support for the east and west base support assemblies. The procedure will be essentially the same as was done last year.

b) Disassemble and remove shielding & crystal palace

Under direction of CAD engineering, CAD technicians, BNL riggers and BNL carpenters shall disassemble and remove large shielding blocks in the PHENIX south tunnel area which would otherwise impede access to the gap 5 area by the BNL walk behind crane. In addition, the so-called crystal palace south, and the gap 5 vapor barrier shall be disassembled and removed.

c) PHENIX technicians shall disconnect the MuID gas panel and other equipment from MuID gap 5 steel and relocate away from gap 5.

d) BNL electricians and PHENIX technicians shall isolate, label, disconnect, and remove cable and piping from gap 5 including any cable tray and piping attached to MuID gap 5 steel. All cables, cable tray etc. on the east side of central pedestal (i.e. the FCAL cables) and any related infrastructure (i.e. the cable protection walkover for the FCAL cables) shall be isolated, labeled, disconnected, and removed for the duration of the installation process.

e) The trench which comprises gap 5 shall be cleaned of all debris and vacuumed to prepare for the grout pour.

f) Lifting fixtures, designed by PHENIX engineering, tested and approved by the BNL Lifting Safety Committee shall be inspected prior to use.

g) All ½-octants shall be pre-surveyed at the factory to establish appropriate external references to facilitate precise installation. All ½-octants shall be marked with a unique designation indicating its final installed position (i.e. 1E through 8E and 1W through 8W in accordance with the illustrated installation plan, attached to

this work permit).

h) A pattern of tapped holes on the MuID steel wall adjacent to gap 5 shall be located and marked by BNL surveyors, then drilled and tapped by PHENIX technicians in accordance with the attached illustrated installation plan and PHENIX drawing number 105-0224-044 rev B.

i) BNL electricians shall repair, replace and or augment lighting in the PHENIX south tunnel as appropriate to adequately illuminate the area for the work described herein.

j) Manlifts and the BNL walk behind crane shall be pre-positioned in the PHENIX south tunnel as appropriate to commence installation.

k) All ½-octants shall be pre-tested in the RPC3 burn-in test stand for a period of time as deemed appropriate by the RPC3 group experts prior to commencing installation.

l) All procedures and this work permit shall be appropriately reviewed, acknowledged and understood by all PHENIX, RPC, BNL trades and CAD personnel involved in the tasks described herein, prior to commencing installation.

2. Mechanical Installation Procedure

    a) Pitch control hardware (unistrut support tracks) shall be installed as illustrated in the attached plan and detailed in PHENIX drawing # 105-0224-001 rev A, attached.

    b) Support base installation

        i. The east and west support bases shall be assembled and installed as illustrated in the attached plan and detailed in PHENIX drawings # 105-0224-010 rev A and 105-0224-001 rev A, respectively, attached.

        ii. The final grout layer shall be poured and allowed to cure in accordance with the procedure developed in the 2009 shutdown for the North subassembly.

    c) Install the 16 ½-octant detector subassemblies as illustrated in the attached plan and detailed in PHENIX drawing #105-0224-001 rev A, attached. The ½ octants are designated and marked according to their intended location within the full station 3 South subsystem (i.e. 1E through 8E and 1W through 8W. The order of installation will be as follows: 1W, 2W, 3W, 4W, 8W, 7W, 5W, 6W, 1E, 2E,

3E, 4E, ,8E, 7E, 5E and 6E. For each ½-octant the procedure will follow the general steps as follows:

i. Load the ½-octant onto the transport cart at the RPC factory in accordance with its destination location as identified on its case and illustrated in the attached plan.

ii. BNL riggers will move the ½-octant on the cart from the RPC factory to the PHENIX south tunnel

iii. Move the cart into the south tunnel and roll it north on the east side of the pedestal to near the south tunnel overhead crane

iv. Riggers, using the south tunnel overhead crane shall lift the current ½ octant from the angled cart to a position in front of the walk behind crane. For west side ½ octants this will include lifting the ½ octant over the beamline. PHENIX technicians shall then attach the front and rear support and rotating wheels and the riggers shall lower the ½ octant onto a suitable open spot on the mezzanine near the MuID steel (for ½ octants 1 and 2, east and west, lower the ½ octant into an open spot in the trough on its intended side) so that the ½ octant rests on the wheels and the ½ octant can then be disconnected from the overhead crane which is moved back to its park position until needed for the next ½ octant.

v. Move the walk-behind crane close and attach the hoist and ½-octant lifting fixture to the appropriate lift position (see illustrations in attached plan).

vi. For ½ octants 1 and 2 (east and west), use the walk behind lift to carefully rotate the 1/2 octant into its installed orientation, rotating on the support wheels. One technician should guide the ½ octant through the technician and prevent the ½ lifting line of force.

vii. Lift ½-octant to its final installed position and secure it as illustrated in the attached plan and detailed in PHENIX drawing #105-0224-001 rev A.

viii. After ever second ½ octant is installed, attach gas and electronics connections as required for minimal non-operational support and test that the electronics and gas

connections are sound, operational and without leaks.

d) As each ½-octant is installed, move the sliding base support assemblies to their "0"-position and make adjustments to the supports to align each ½-octant to its reference point as marked by survey on the gap 5 steel wall and measured using the alignment tool.

e) After all ½ octants are installed, survey to record installed positions of all ½-octants.

3. Electrical and gas connections

The RPC3 South electrical and mixed gas utility support plans have been reviewed by the CAD ESRC and found to be in compliance with all relevant BNL, CAD and PHENIX general requirements. Power and electrical infrastructure (cable trays and power cables) will be installed by BNL electricians in compliance with all applicable codes and regulations. Electrical signal, electronic control, safety and gas system components shall be installed by qualified PHENIX technicians and/or RPC system experts. The following general steps will be carried out in order:

a) Install gas supply racks and monitoring in PHENIX gas mixing house.

b) Install cable and gas line management support.

c) Install gas supply and return lines from mixing house to PHENIX tunnel south.

d) Install gas distribution panel/rack and bubbler(s) at PHENIX tunnel south

e) Install supply and return lines from gas distribution panel to individual ½-octants.

f) Install rack room controls and electronics in support of RPC3 South in the PHENIX rack room.

g) Install 2 full size detector electronics racks in west trough of PHENIX tunnel south.

h) Install power to RPC3 south racks.

i) Install RPC3 south electronics equipment in the 2 racks.

j) Install LV and signal cables in cable trays, making sure that there is a barrier between HV and signal cables.

k) Install communications links to rack room electronics

After all gas system, electrical, electronic and safety system components have been installed such systems shall be commissioned by a series of tests to affirm proper operation of all components and integration of the detector subsystem into the overall PHENIX experiment and data acquisition (DAQ) system.

4. Restoration of displaced equipment, services and infrastructure

After installation is completed, accelerator infrastructure, shielding and equipment removed for RPC3 South installation access shall be restored/replaced as follows:

a) BNL electricians and PHENIX technicians shall install new support infrastructure to support restore MuID cable and piping in gap 5 and cables, cable tray etc. on the east side of central pedestal (i.e. the FCAL cables) and any related infrastructure (i.e. the cable protection walkover for the FCAL cables) shall be reinstalled in its original form or functional equivalent.

b) Remove manlift, crane and any other construction equipment from the area near gap 5

c) Construct the new thermal/vapor barrier in accordance with PHENIX thermal vapor barrier plan dated June 30, 2009 as supplied to CAD engineering July 1, 2009. (i.e. the plan used for the thermal/vapor barrier in the north tunnel.)

(Note: This task will be performed by external contractors under direction of CAD engineering. Additional documentation of this task may be generated by CAD personnel.)

d) BNL riggers shall reinstall the large shielding removed as described step 1 (b) of this document.

e) Manlifts and the BNL walk behind crane shall be removed from the PHENIX south tunnel as.

5. Work conclusion

When all work described in this work permit has been completed, the PHENIX work coordinator for this set of tasks shall collect feedback from all parties (BNL trade groups, CAD engineers and technicians, PHENIX engineers and technicians and RPC experts). This feedback shall include critical review of any problems encountered during

installation, solutions to such problems, changes to work procedures described herein during the conduct of this work, suggestions for improvements in equipment procedures and techniques and any other information deemed useful and/or relevant by the PHENIX work control coordinator. Such information shall be appropriately disseminated to the various affected/interested parties and a copy of this information shall be attached to this work permit when it is closed out.

(Note: Lessons learned from the tasks performed during the 2009 summer shutdown to install the RPC3 North detector have been incorporated into the illustrated installation plan which accompanies this work permit and into the steps described above into this work permit for the installation of the RPC3 South detector subsystem.)

RPC Installation Plan
During the 2010 Summer Shutdown

Don Lynch

5/28/2010

RPC 3 North Installation

During the summer 2010 shutdown maintenance period some additional tasks will be required to complete the RPC3 North installation including:

- Resolving detector grounding issues
- Completion of RPC operational gas supply monitoring and control equipment in the PHENIX gas mixing house
- Final survey measurements
- Any other unresolved issues

The details for these tasks are worker planned tasks that will be coordinated, and evaluated during daily and weekly planning sessions by PHENIX engineering and technical staff.

RPC 3 South Installation

The RPC3 South detector subsystem installation effort is currently well under way. Support efforts related to the South subsystem began immediately after mechanical installation of the North subsystem was completed last fall. The PHENIX technical support staff expects to complete installation of the South subsystem by the end of the 2010 maintenance shutdown (December 1, 2010). The various tasks related to the South subsystem installation are as follows:

1. **Evaluation of RPC3 N. installation and application of lessons learned to the RPC3 S. installation plan.**
2. **Fabrication of support and assembly components for RPC3 South installation.**
3. **½-octant assembly, testing and preparation for installation.**
4. **Installation site preparation.**
5. **Mechanical installation.**
6. **Absorber Installation.**
7. **Electrical and gas services and environmental control.**
8. **Site restoration.**
9. **Installation closeout.**

These Tasks are described and illustrated in the following sections of this plan.

1.Evaluation of RPC3 N. installation and application of lessons learned to the RPC3 S. installation plan.

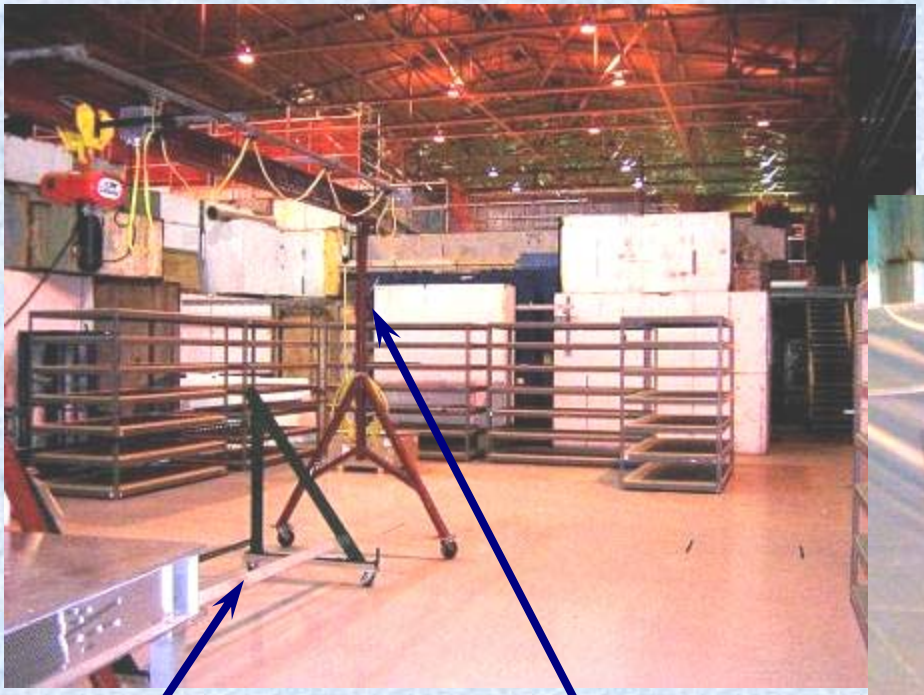
After completion of the 2009 summer shutdown, and the completion of the mechanical installation of the RPC3 North detector subsystem, PHENIX engineers and technicians met and evaluated all aspects of the installation with the following conclusions:

- **Items which worked well, including the factory support equipment designed for the RPC3 North (Tilting transport Table, Burn-in Test Stand, Humidified storage racks, Angled transport cart [4 in total], Dark Current Test Stand), thebase support assembly, ½ octant interconnecting blocks, pitch control system, lifting fixtures and temporary support rollers were well designed and concieved and required no modifications. They will be used similarly in the SouthRPC3 installation.**
- **The upper support concept for temporary support of the upper 4 most ½ octants did work but improvements were suggested to make the installation easier and safer. These improvements have been implemented and documented in PHENIX drawings.**
- **It was noted that labeling the lifting holes on the lifting fixtures makes it easier to determine the correct lifting point for individual ½ octant lifts. It was also noted that the cg of the ½ octant was slightly off from the calculated cg. A test was proposed to determine the actual cg for a completed ½ octant. This has been done.**
- **Methods of coordinating work with BNL trades which worked well for the North will be repeated for the south (pre-installation plan review, daily work planning sessions, etc.)**

All lessons learned tasks have been addressed.

RPC Factory

Humidified storage for gaps and modules



Angled cart

Half ton A-frame crane

Tilting transport table

2. Design, fabrication, assembly, test and commissioning of RPC factory support equipment:

Tilting transport Table
Burn-in Test Stand
Humidified storage racks
Angled transport cart (4 in total)
Dark Current Test Stand

These items were completed in 2009 for the RPC3 North station, and all are perfectly suited to support the RPC3 South station without modification.

3. ½-octant assembly, testing and preparation for installation:

- Initial assembly on assembly table
- Electronics and gas connection initial tests inside factory
- Burn-in tests

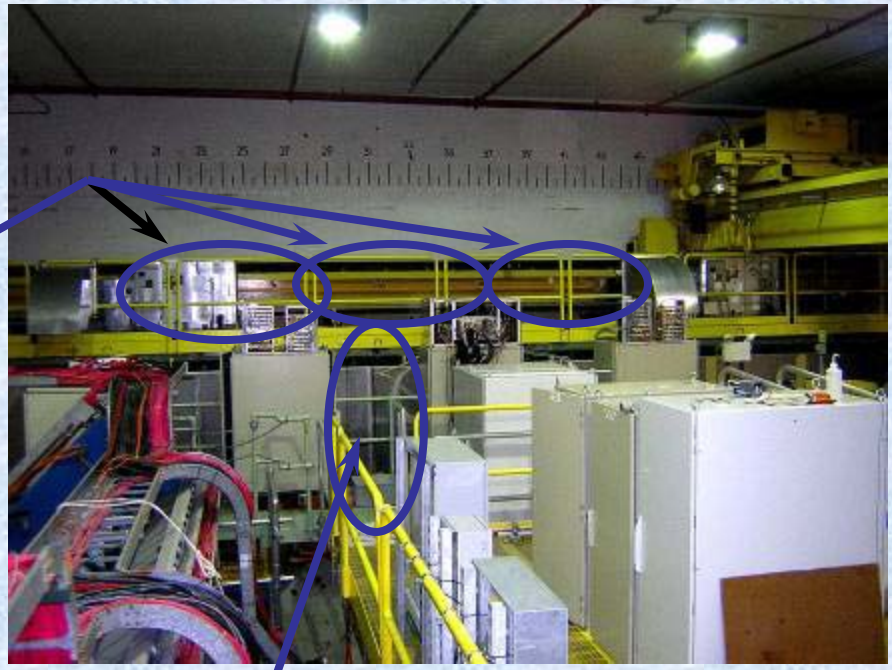
These tasks have commenced at the RPC factory and we are currently on schedule to produce all of the ½ octants well within the schedule.

4. Installation site preparation:

- Temporarily re-locate south tunnel shielding, access catwalks, F-Cal wiring, and any other equipment which potentially would interfere with installation
- Disassemble vapor barrier and crystal palace
- Disassemble and remove the RPC3 prototype, support structure and accessories.
- Label and remove/re-route all piping from gap 5
- Temporarily reroute wiring
- Clear debris from gap 5
- Pre-grout preparation: sealing of cracks and damming openings for grout containment
- Survey markings for alignment and precision support structure attachment to gap 5 steel and adjacent surfaces
- Install wood access and work platforms above the MuID steel
- Install pedestal and side wall unistrut pitch control rails and hardware
- Install side wall custom narrow cable trays
- Install above MuID ½ octant support structure (for HO's 7 & 8)

There are 51 pipes which will need to be temporarily relocated while the ½ octants are installed, then permanently re-routed. This is the single most difficult task and is expected to be the most time consuming effort. It is expected that this effort will take approximately one month to re-locate prior to ½ octant installation and 6 weeks to re-route after ½ octant installation. This is a delicate task, but a great deal of planning and consideration has gone into this task. The other items in this task list are similar in their requirements to efforts performed for the North subsystem and, as such, are expected to be accomplished without difficulty.

Access and work platforms for above the MuID steel. (Note: these are similar to platforms built for RPC3N installation.)



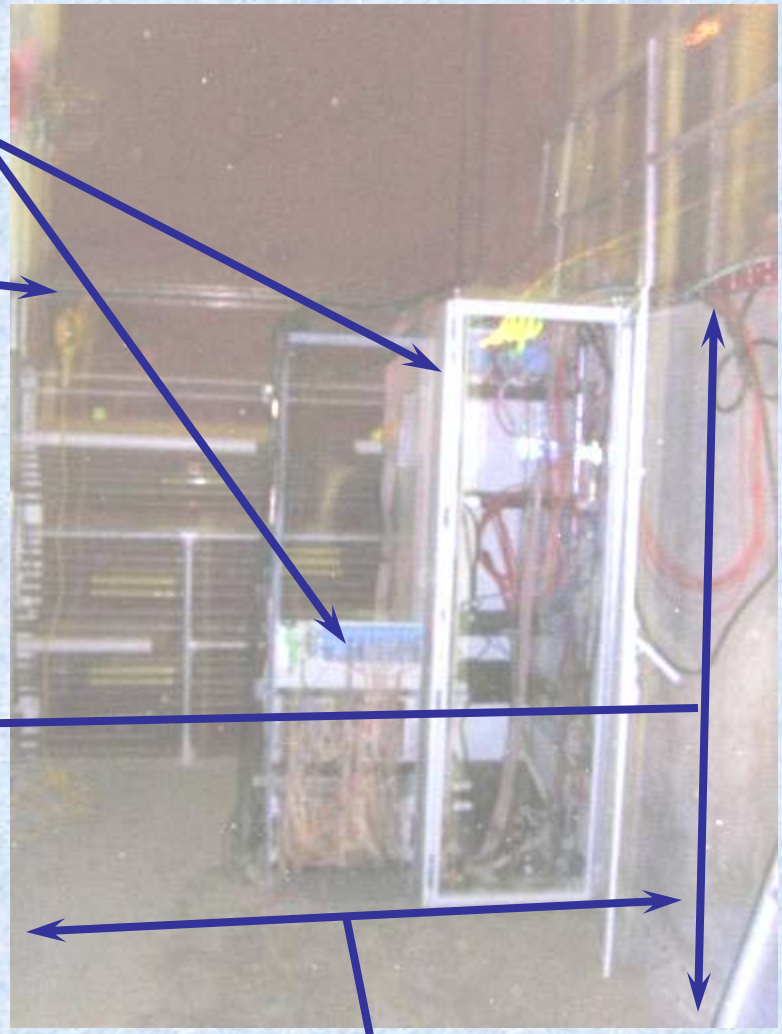
Platforms go here

Stairs Go Here

Dimensions of east and west troughs

West trough: once shielding is gone there will be plenty of room to park ½ octants and reorient (HO1 & HO2). On east side there is less room due to FCAL rack and piping walkover. We can park HO's at angle with one end up on walkover.

Need to add another rack on west side. May need to temporarily relocate existing rack. Will need to temporarily remove cable tray.



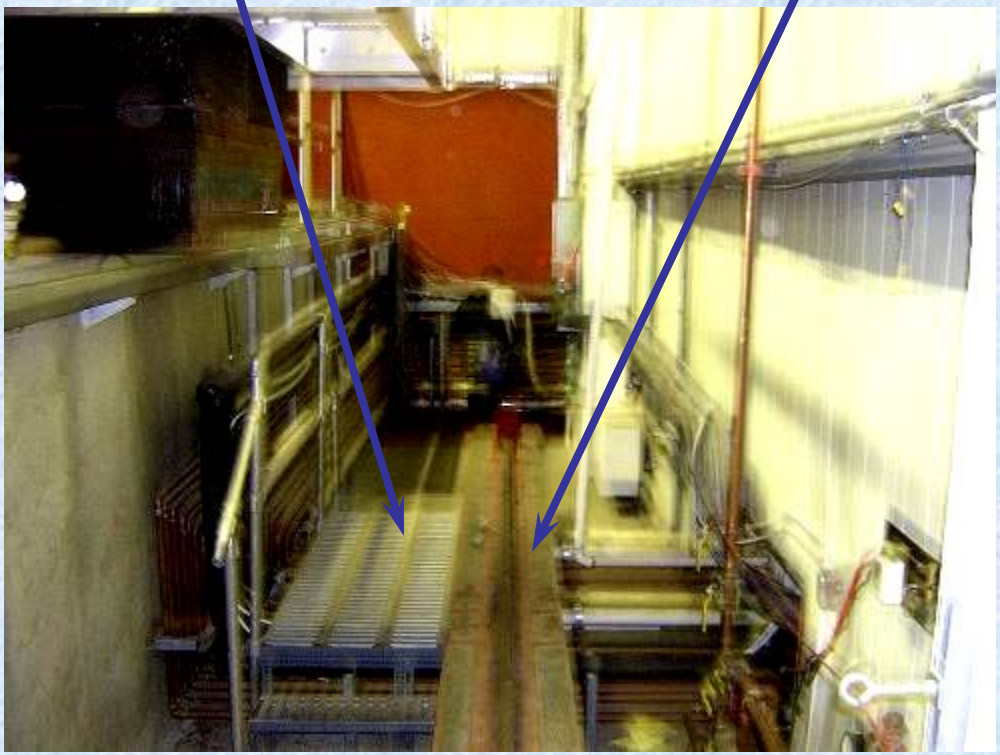
Height of pedestal from trough floor: 79", pedestal floor to ceiling: 189" same dimensions east and west

Width of west trough: 90.5"
On east trough only 77" wide clearance

East Side Trough

Piping walkover

Crane tracks are more in the way on south side but shouldn't be a problem. Coverage is ~ the same.



Power cables to overhead tray to be temporarily relocated

Gap 5 between pedestal and 5 steel

MuID gas panel and control wiring to be temporarily moved, as was done on north side

Vapor barrier, crystal palace and cable tray to be removed

Trash in Gap 5 similar to north side. To be cleaned up and sealed for grouting. Doesn't look any worse than north side.

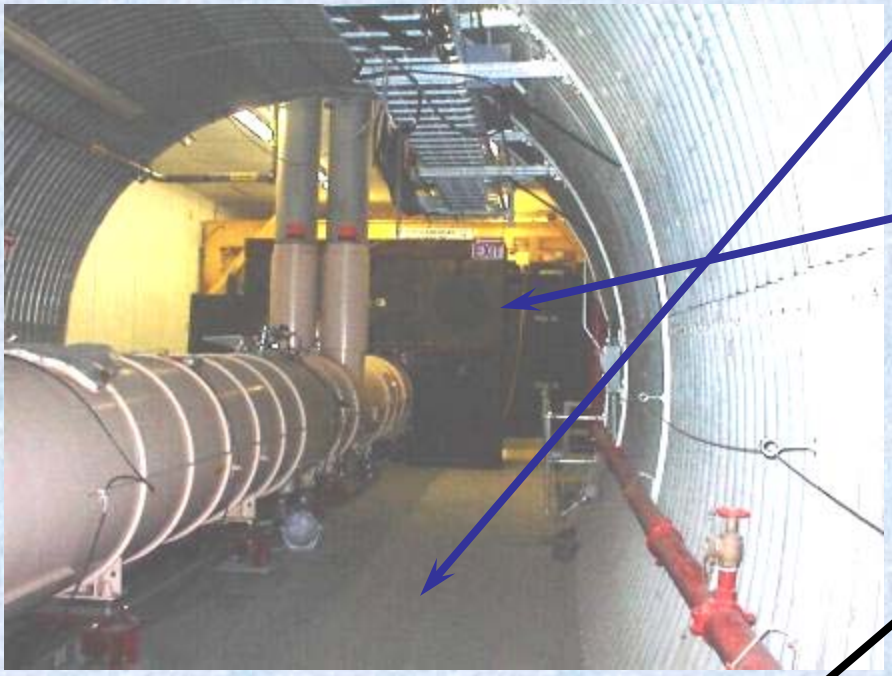
RPC3 South

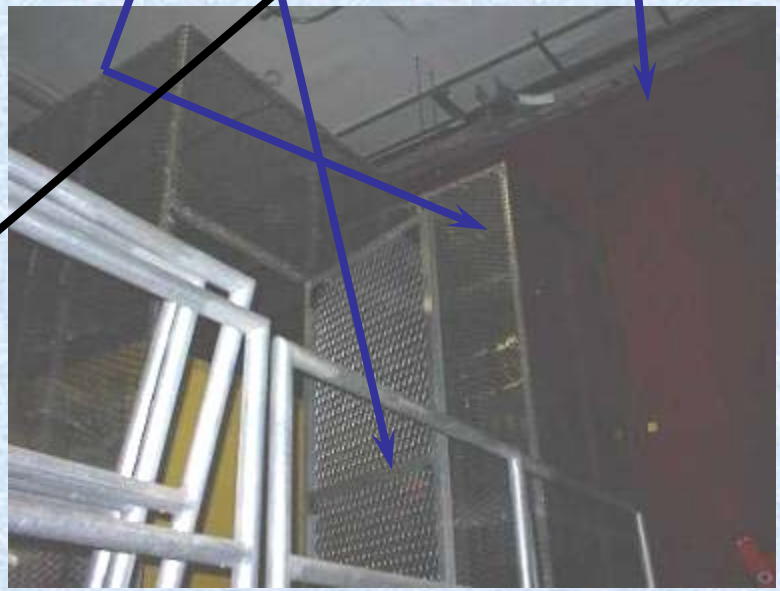
No major interferences to bringing equipment and ½ octants in from outside

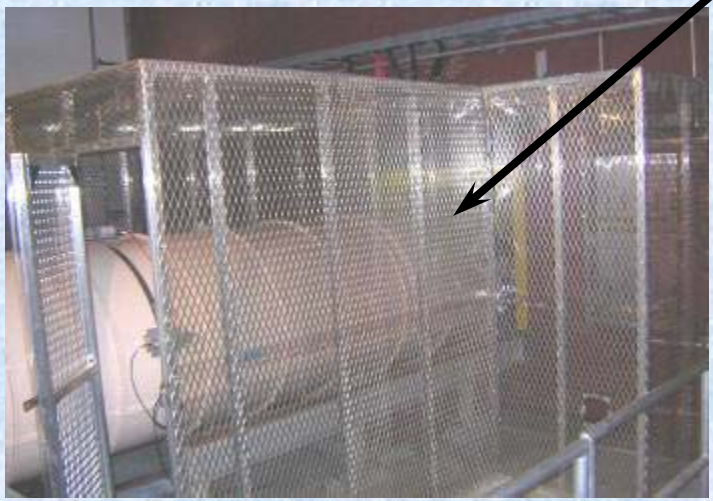
Prior to start of shutdown

Shielding in place

Cable trays, vapor barrier and crystal palace in place







List Of Gas Lines

to be temporarily relocated and rebuilt in support of RPC3N

"Front Row" in GMH
Go to West Side in the IR

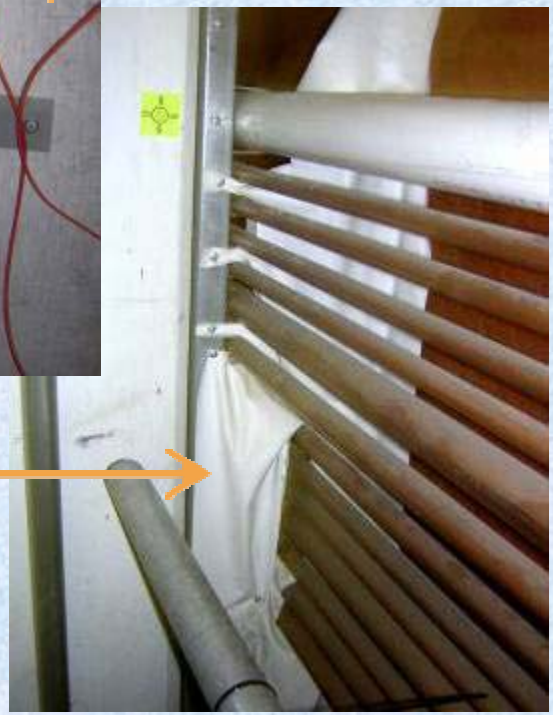
Rack purge air supply---------- 1-1/8”
Detector Purge Air Supply---------- 1-1/8”
North MuID Return---------- 1-1/8”
MuID North Supply----------1-5/8"
MuID North Purge Supply----------1-1/8”
MuTr North Supply----------1-5/8”
MuTr North Return----------1-5/8”
DC/PC BVP Return (dead)----------1-5/8”
Nothing----------2-5/8”
Beam-Beam N2 Cooling----------5/8”
Helium Bag Supply----------5/8”
TOF West Supply----------5/8”
West RICH Control #1----------3/8”
West RICH Control #2----------3/8”
West RICH Control #3----------3/8”
West RICH Buffer Return----------3/8”
West RICH Supply----------1-1/8”
MuTr South Supply----------1-5/8”
MuTr South Return----------1-5/8”
MuID South Return----------1-1/8”
MuID South Supply----------1-5/8”
MuID South Purge Supply----------1-1/8"

"Back Row" in GMH
Go to East Side in the IR

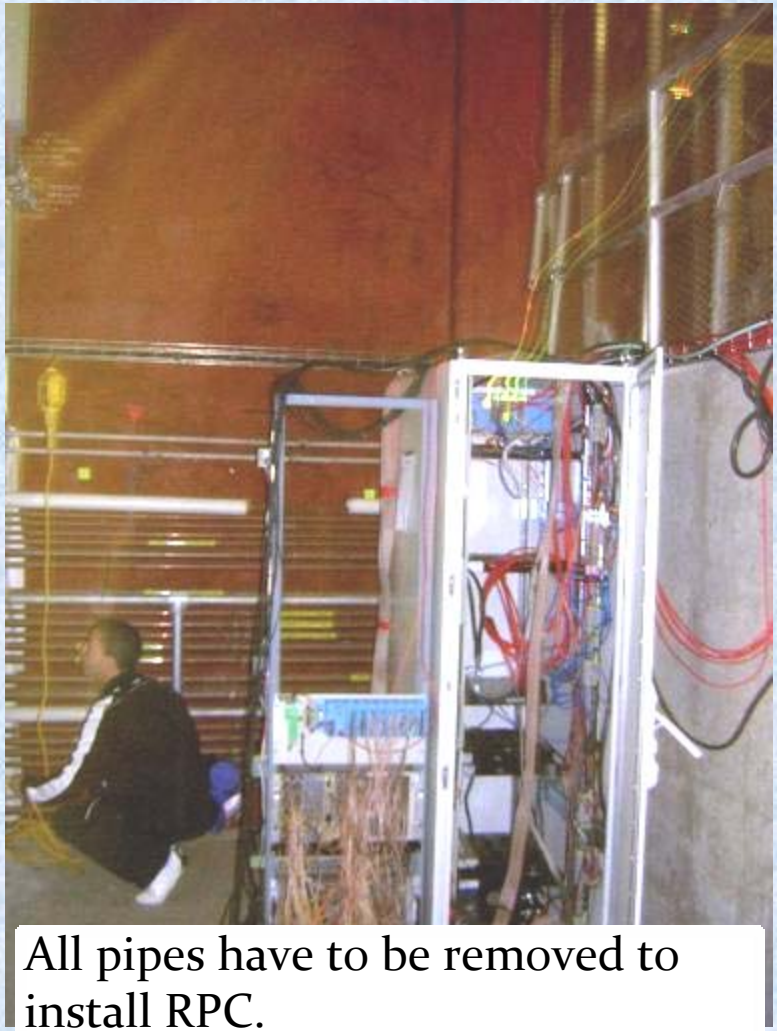
RPC----------1/2"
East DC Supply----------5/8"
West DC Supply----------5/8"
Aerogel Nitrogen----------7/8"
TRD Nitrogen----------7/8"
Nothing----------7/8"
West DC Return----------1-5/8"
RPC Vent (Not Used)----------1-1/8"
Nothing----------5/8"
Nothing----------3/8"
Nothing----------3/8"
East DC Return----------1-5/8"
TEC BPV Return (Dead)----------1-1/8"
PC Supply----------1-5/8"
TEC Supply----------1-5/8"
DC/PC Return----------2-5/8"
TEC Return----------2-5/8"
East RICH Supply----------1-1/8"
TEC CO2 Supply----------5/8"
East RICH Control #1----------3/8"
East RICH Control #2----------3/8"
East RICH Control #3----------3/8"
East RICH Buffer Return----------3/8"

Some of the pipes involved

Pipes go under beam pipe



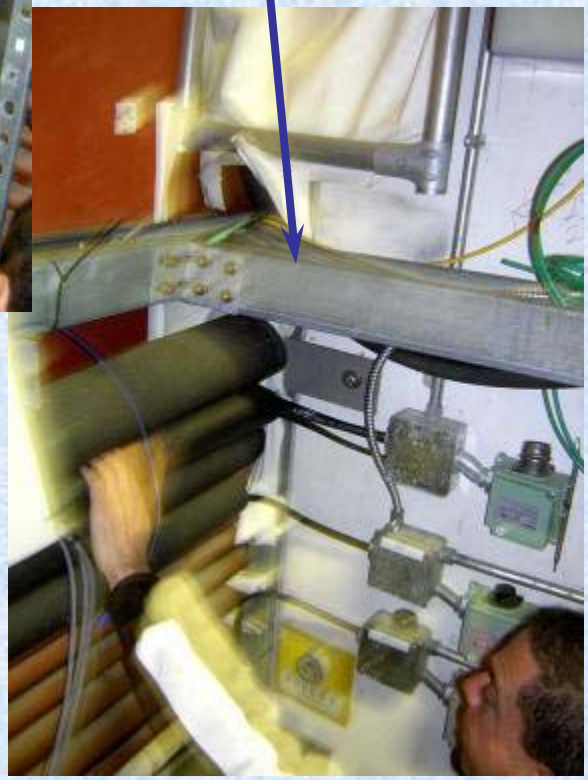
Gap behind MuID



All pipes have to be removed to install RPC.

Piping and cable tray interference on east side

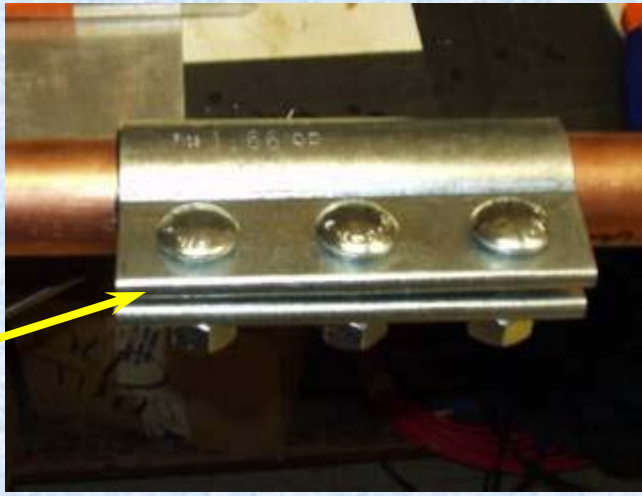
Cable trays that have to go



PHENIX Gap 5 Piping Relocate for RPC3S installation with temporary poly lines, modify location and support structure to coexist with RPC and restore hard piping.

- At Start of shut down (month +)
  - Label all sides of pipe where they will be cut
  - Cut lines and try to remove in one piece (must use tube cutter)
  - Cap and store removed sections
  - Run temp polyflow lines for life support

- After RPC South is installed (5-6 weeks +)
  - Remove temp poly lines
  - Install removed sections of pipe
    - Some lines need to be relocated and modified.
    - No soldering
      - 1-1/8" or less → Swagelok (metal seal)
      - All larger → morris coupling with custom gasket
  - Pressure test all lines for leaks



5. Mechanical installation:

- Install base support structure
- Install pitch control and upper level support structure
- Install individual ½-octants
- Test individual ½-octants
- Final alignment and survey

While this was the most challenging task during the North subsystem installation, our experience and success during last year, coupled with the application of a few lessons learned to make improvements gives us a high degree of confidence that this task will be accomplished within schedule.

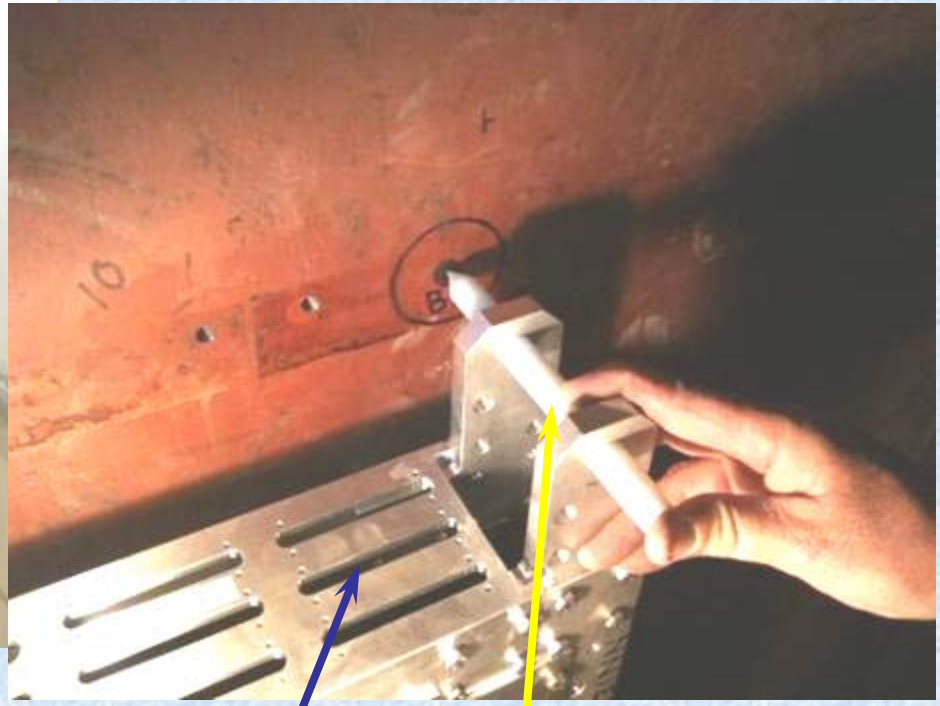
a. Clear and clean gap 5 of all debris. Build grout dams at east and west ends of MuID steel plate #5 (carpenters) and seal all potential leak paths with sealing foam insulation/sealer.

b. Install and align west translating base, then east base. Use ½ Octant HO1W, survey markings from previous step and alignment tool.

c. Install and align east translating base, then east base. Use ½ Octant HO1W, survey markings from previous step and alignment tool, and make adjustments as necessary to the alignment balls on HOW1.

RPC3 South

Installing East and West bases



Alignment tool

Alignment of base using empty ½-octant

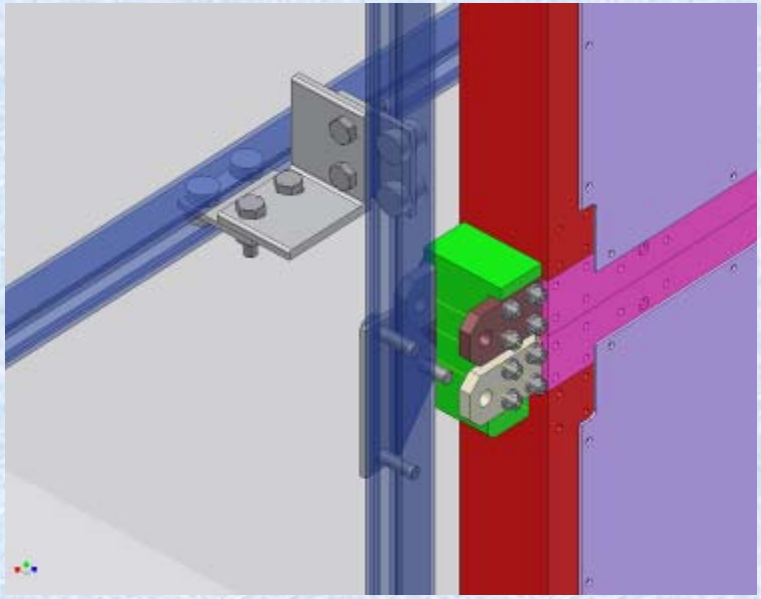
RPC3 South

Health Physics has determined that Grout mixers must wear respirators when mixing.

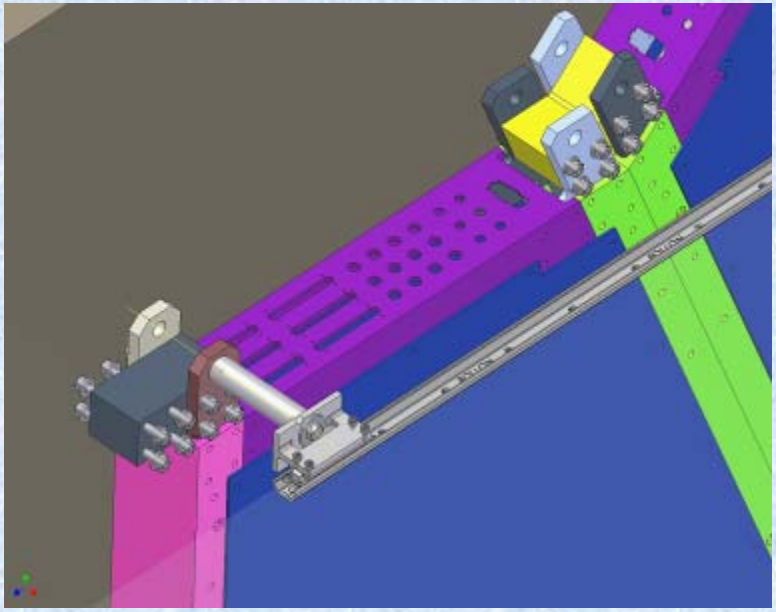
Need to improve venting to outside (should be easier on south due to proximity of exit)

Experience indicates that grouting should be started at east and west outer ends and worked back to the middle.

Grouting in the bases

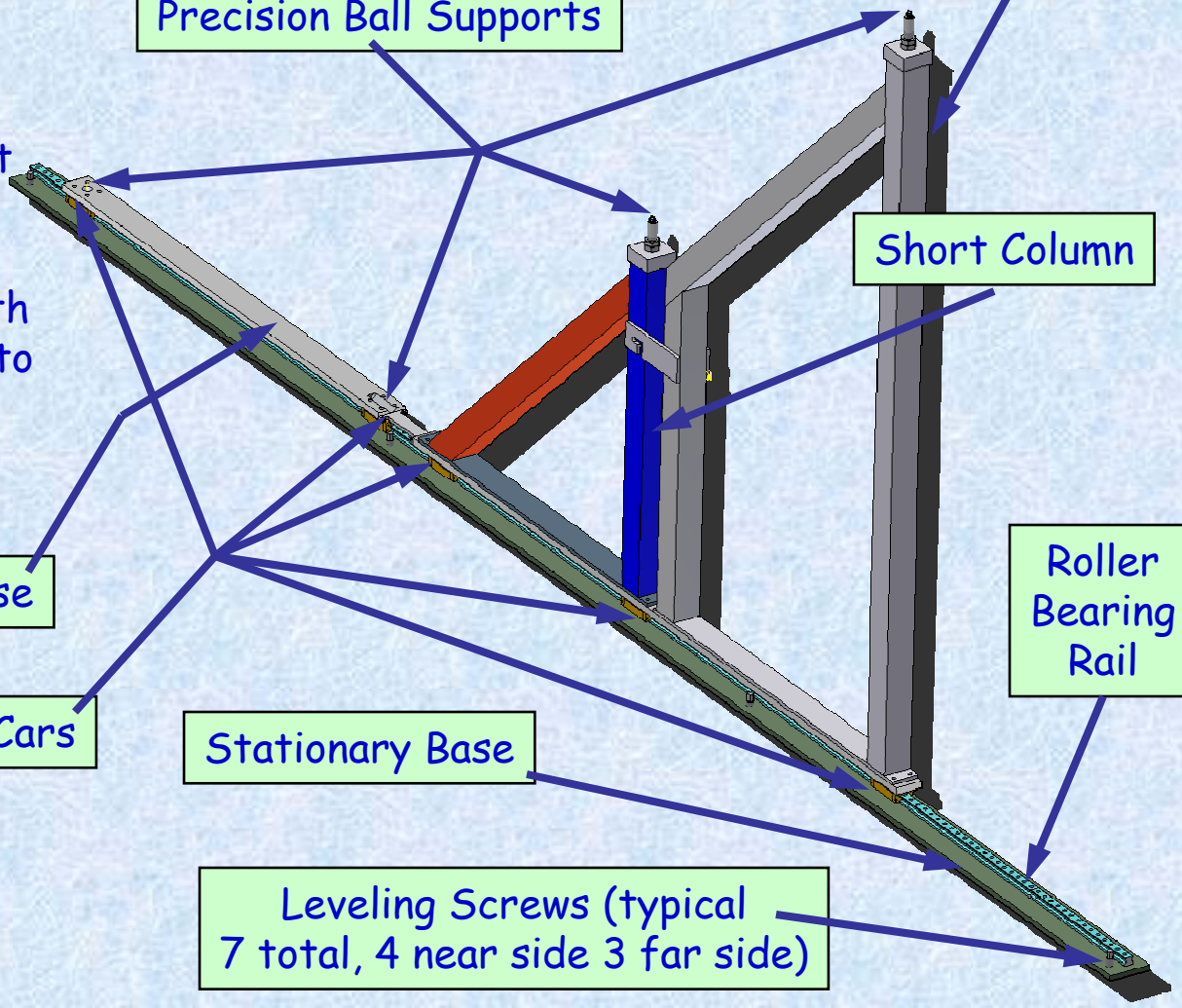


Pitch Control unistrut and clamps

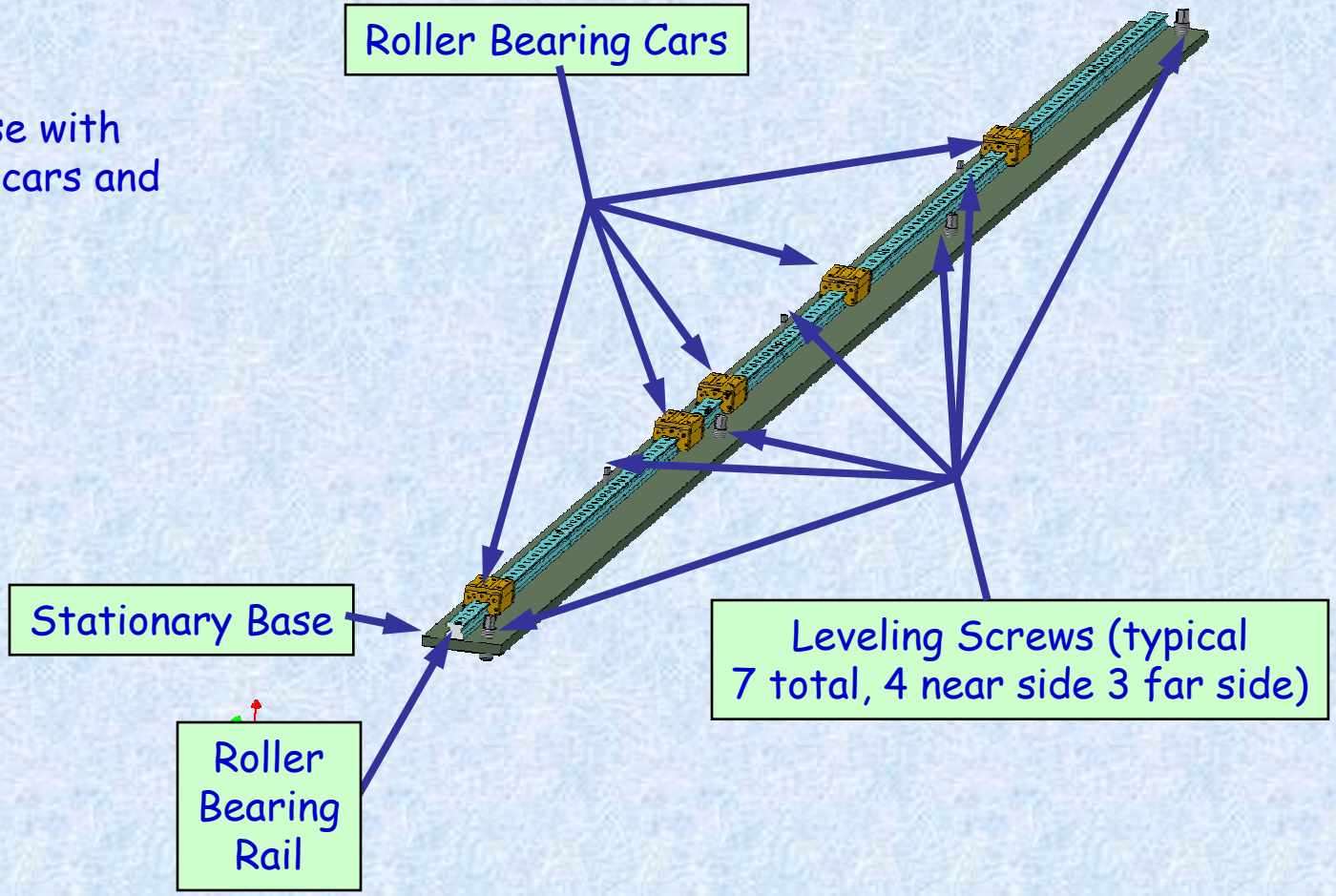


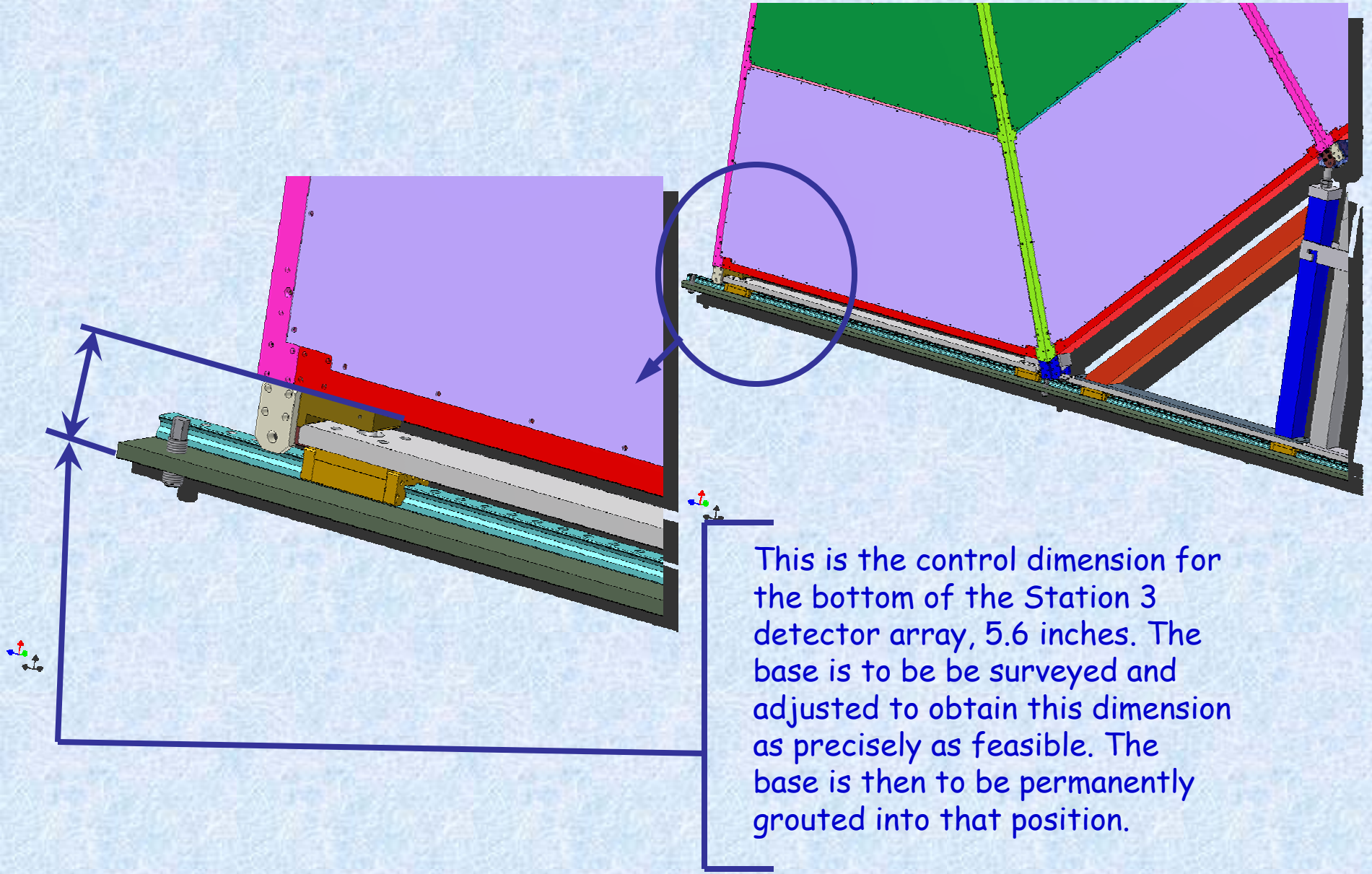
Sliding Half Station Support Assembly

Sliding support assembly provides a precision support for 8 half octants with precise control of vertical and longitudinal position with varying horizontal position to accommodate installation clearance requirements for each individual half octant



Stationary Base with Roller Bearing cars and rails.



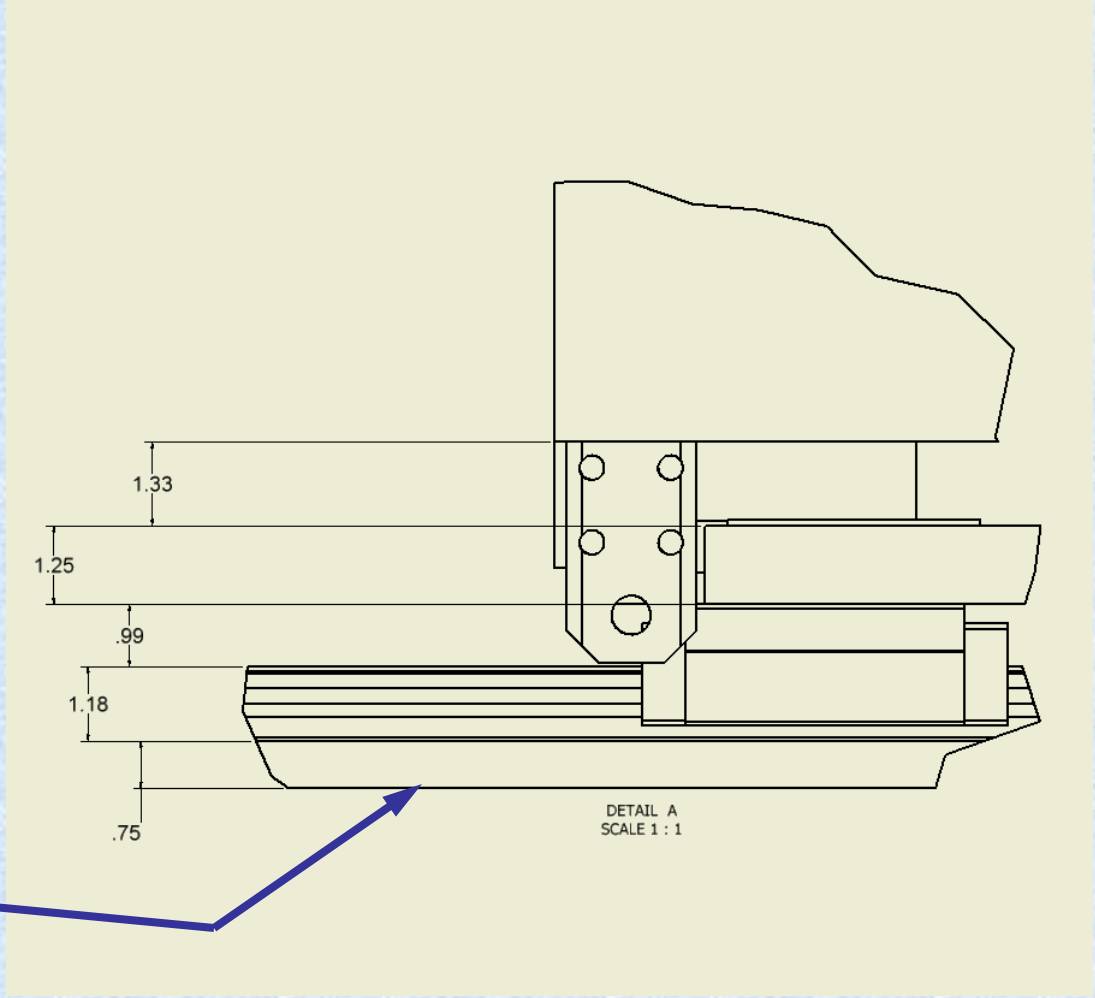


This is the control dimension for the bottom of the Station 3 detector array, 5.6 inches. The base is to be be surveyed and adjusted to obtain this dimension as precisely as feasible. The base is then to be permanently grouted into that position.

This distance is 5.6" maximum
Possible stackup:

.75" baseplate
+ 1.18" rail
+ .99"(above rail) pillow block
+ 1.25" carriage plate
+ .75 to.1.08" mounting balls
+ .25" Ball Pad
/- 0 to .33" adjustment
= 5.6"

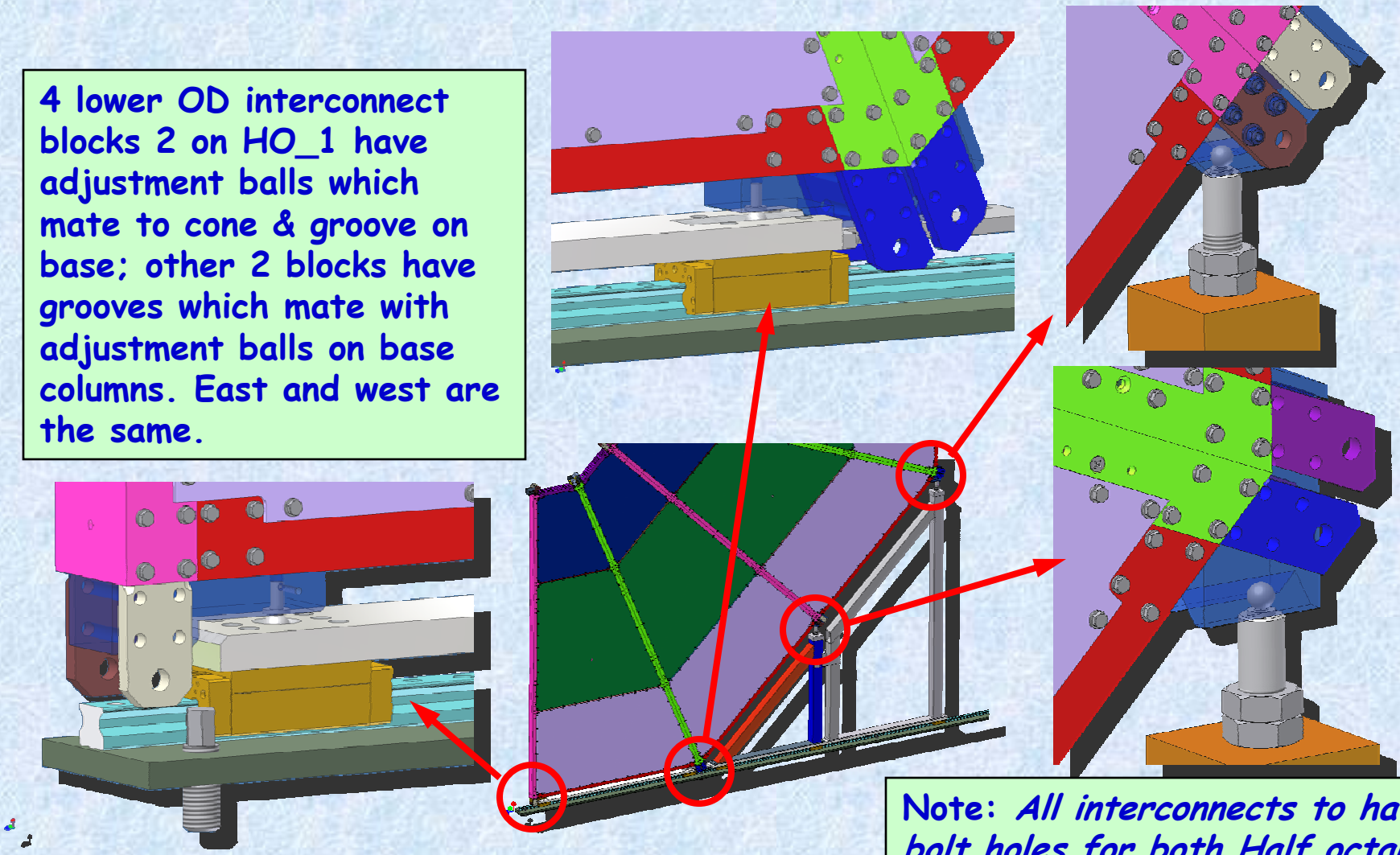
Grouted level underside of fixed baseplate at 200 Inches below nominal beam height



Interconnecting pieces for inter-half-octant joints

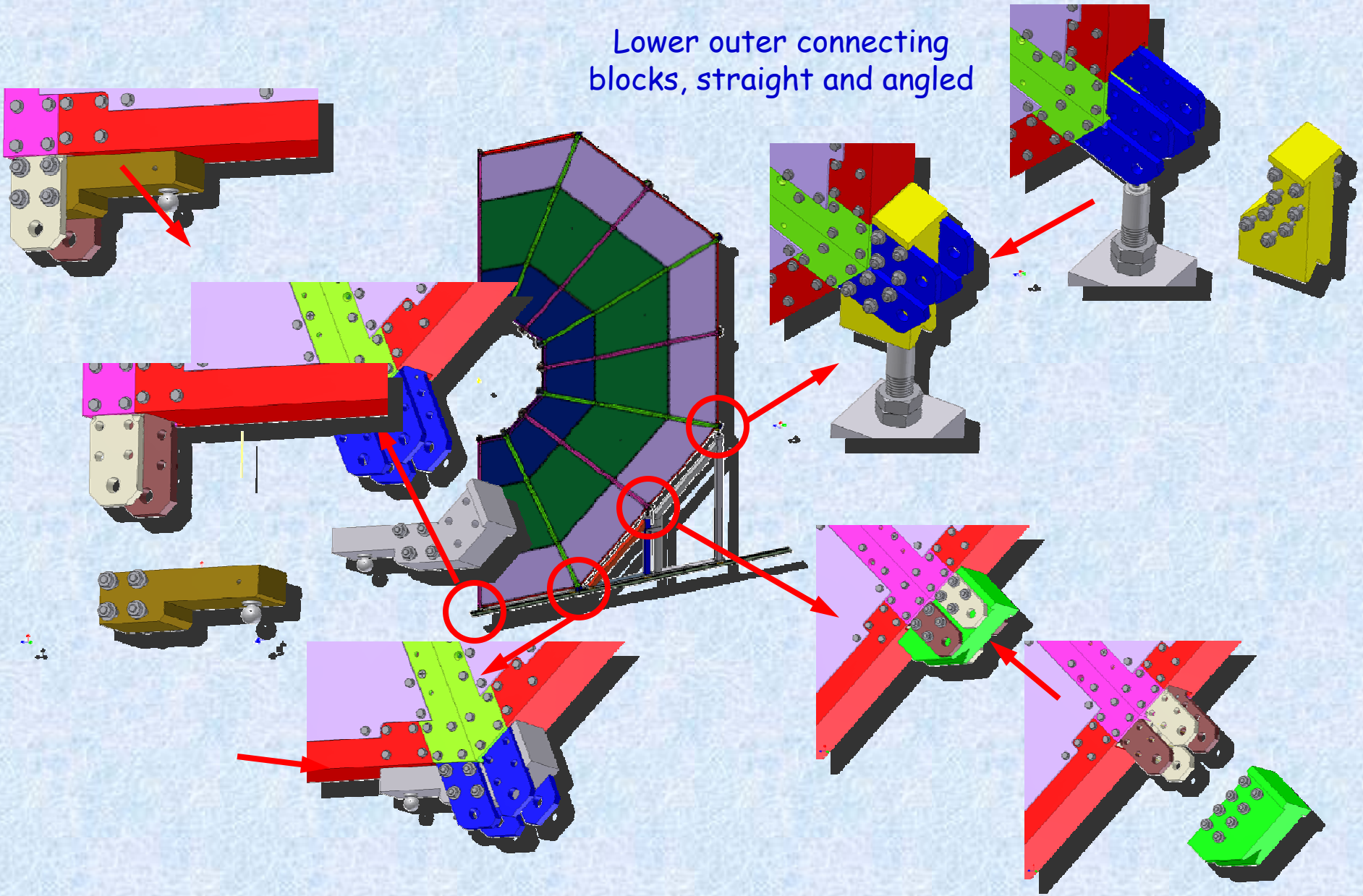
- Bottom 4 joints have ball ends to seat into sockets on rail cars and self locking/self aligning features (cannot be reached) 1st octant has adjustable ball mounts, 2nd and 3rd octants have grooves – mating ball mounts are on sliding base
- Next 5 have self aligning features to assist alignment (3 can be reached from outside, 1 from inside, 1 from top)
- Outer interconnnecting blocks have self locking tabs. Where possible they will also be bolted.
- All inner joints require no locking tabs (can be reached easily from tunnel for bolting)

4 lower OD interconnect blocks 2 on HO_1 have adjustment balls which mate to cone & groove on base; other 2 blocks have grooves which mate with adjustment balls on base columns. East and west are the same.

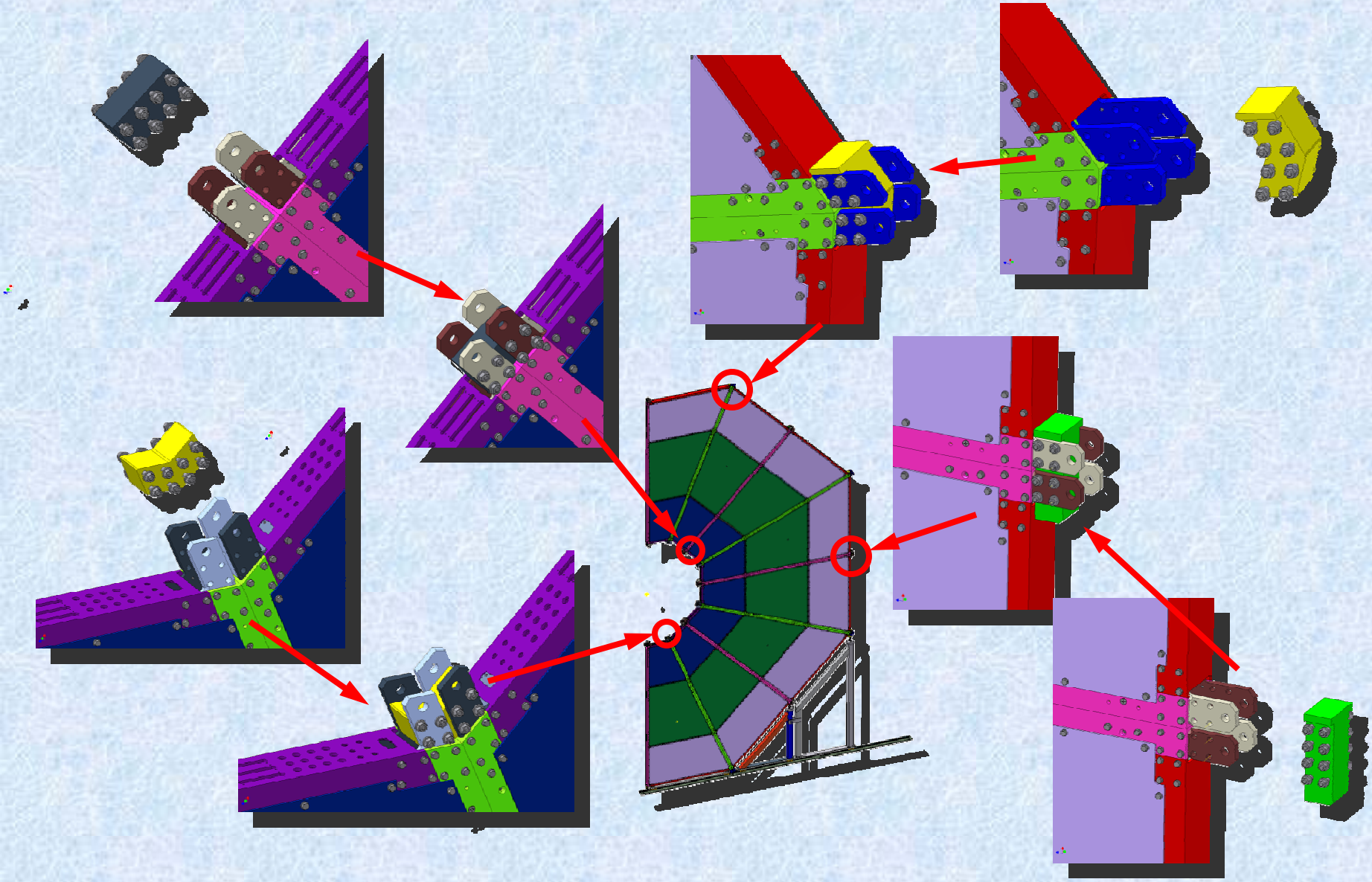


Note: *All interconnects to have bolt holes for both Half octants connected whether used or not.*

Lower outer connecting blocks, straight and angled

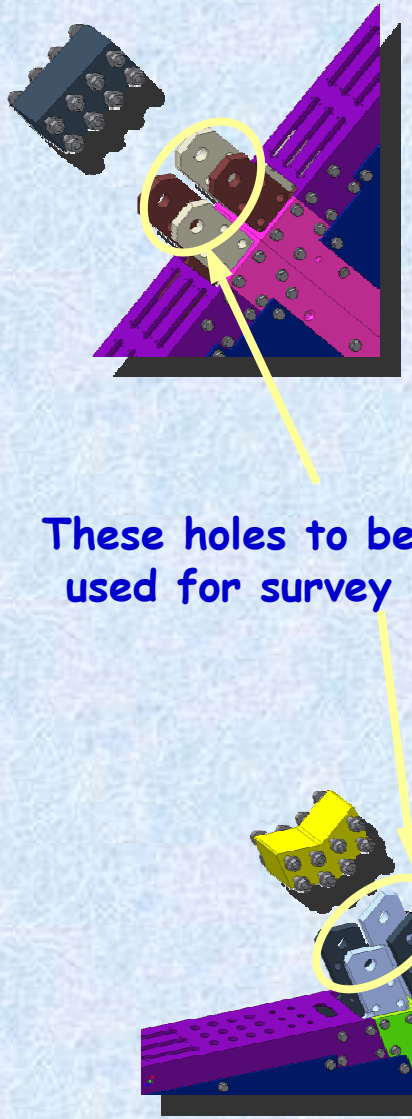


Upper inner and outer connecting blocks, straight and angled



Each half octant has holes on each of its mounting brackets on the brackets which will be used for mounting survey targets which will be visible to survey equipment in the tunnel. These targets wil be relatable to the IP by survey and will have been presurvry to relate the inner positions of appropriate detector components. Initial survey of HO_1 W and HO_1 E to establish verticality of the HO_1's which are adjustable will also use these references. All other HO's are stacked into fixed positions by bolted connections and survey is used to record their final positions.

(Needs to be coordinated with half octant fabrication.)



5.d Mechanical installation, ½ octant #1, east [HO1W]

- At the factory PHENIX techs use the tilting transport table to extract the ½ octant (HO) from the burn-in test stand, attach the appropriate interconnecting blocks to all 4 mounting brackets, then use the A-frame crane and long lifting fixture to mount HO1W on the angled transport cart long side up, narrow end to the right. BNL riggers then wheel the cart onto the adjustable flat bed truck, secure the cart to the bed and deliver the cart to the tunnel loading dock south of the PHENIX IR. Long lifting fixture should remain on HO1W with the lifting clamp in position # 5/7.
- HO1W is then rolled on the angle cart through the access tunnel to the main tunnel and into the PHENIX south tunnel area where it is lifted from the angled cart by the tunnel crane towards the IR and lowered into the west trough. When HO1W is about belt high, attach the parking, rotating wheel fixtures to the mounting brackets on the lower side of both ends of HO1W.
- Lower HO1W to the trough floor and allow it to be fully supported by the parking/rotating wheels. Remove the lifting clamp and move it to position #1.
- Using the walk-behind crane lift HO1W and allow it to rotate the HO into the installed orientation, then lift the HO above the pedestal and lower it onto the east support base, making sure the alignment balls seat fully into the sockets on the support base. Remove the lifting fixture from HO1W.
- Use the survey markings and survey tool to align HO1W to its appropriate position.

RPC3 South

½-octant parking and orienting fixtures (wheels)

HO1W ½-octant installed

Wheel axels to be cleaned and deburred with emory cloth before and after each use. (Ease of assembly/disassembly)

5.e Mechanical installation, ½ octant #2, east [HO2W]

- Extract HO2W from the burn-in test stand and mount it on the angle transport cart with the short side up, the narrow end to the right, interconnecting blocks on the short side inner and outer mounting brackets only, the short lifting fixture attached with the lifting clamp on the table/cart position.
- Deliver HO2W to the PHENIX south tunnel and move it into the west trough supported by the parking/rotating wheels using the over head crane.
- Move the lifting clamp to position 2 on the lifting fixture and use the walk behind crane to lift HO2W over the pedestal and lower it onto HO1W, taking care not to disturb HO1W from its aligned position. The outer connecting block slides into the HO1W long side outer connecting block and the HO2W inner mounting bracket is then bolted into the interconnecting mounting block already on the HO1W long side inner mounting bracket.
- Use the survey markings and survey tool to align HO2W to its appropriate position, using the still connected lifting fixture and walk behind crane to nudge HO2W into alignment as necessary, then tighten the bolts on the inner connecting block for HO1W and HO2W. Remove the lifting fixture from HO2W.
- After HO1W and HO2W are in place, perform electronics and gas tests to assure that electrical and gas system integrity was not affected during installation.

- (Note: If electrical and/or gas system integrity is faulty at this step remove the offended HO by reversing the installation process (if HO1W is faulty, both HO's must be removed) then repair the fault(s) then repeat the installation for the HO(s).

Installation of HO2E

RPC3 South

Make sure HO2 is lowered into place in correct angle so it doesn't cause HO1 to shift when installaing.

5.f Mechanical installation ½ octants #3 through 8 west and 1 through 8 east

- **The process is similar to that for HO's 1W and 2W with the following additional comments:**
  - **Installations continue in groups of 2 HO's after which the electrical and gas checks are made and repairs affected, if necessary.**
  - **Odd numbered HO's are placed on the angled cart with the long side up, the narrow end to the right, the long lifting fixture mountedto the long side and the lifting clamp in the 5/7 position. Appropriate interconnecting blocks are attached on the side which will receive the lifting fixture, except HO1E also has its short side outer mounting block attached but not its inner block. Even numbered HO's are placed on the cart with the short side up, narrow end to the right, short lifting fixture attached to the short side and the lifting clamp in the table/cart position.**
  - **Only HO's 1 & 2, east and west need to be lowered into the troughs and rotated as lifted. Ho's 3 through 8 east and west are transferred from the angled cart to the IR side of the walk behind crane where they are transferred onto the parking/rotating wheels and parked on the pedestal, east or west side as appropriate.**
  - **HO's 3 through 6 have the lifting clamp moved to the appropriate marked lifting point on the lifting fixture and lifted above then lowered onto the previously installed HO, aligned with the survey marks on the wall and bolted together on both the inner and outer interconnecting blocks.**

5.f Mechanical installation ½ octants #3 through 8 west and 1 through 8 east (continued)

- **HO's 7 & 8 are lifted above their respective pivoting points then the under side lifting fixture is attached, the rotating piston is attached a safety backup winch line is dropped from above the MuID steel, the HO's are rested on the rest pins temporarily and the walk behind crane is used to remove the upper side lifting fixture. hO's 7 and 8 are then rotated into position and attached to the upper MuID steel support structure, previously installed**

HO3W

HO4W

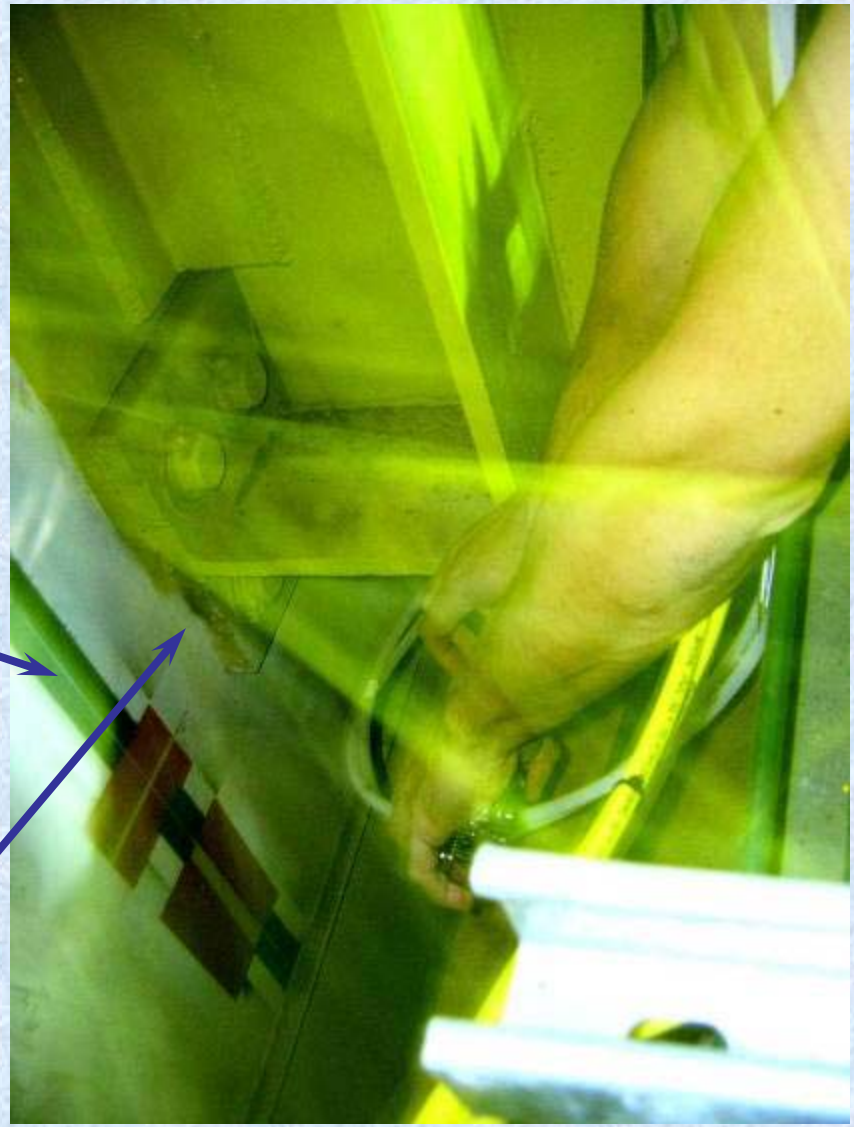
RPC3 North

Installing HO5W

Installing HO8W
(Note both lifting fixtures in use and piston ready to rotate HO)

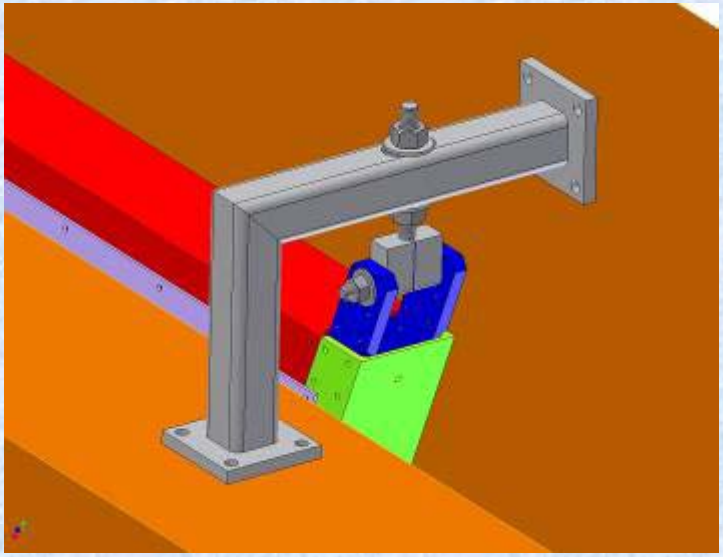
Interferences at top of gap 5

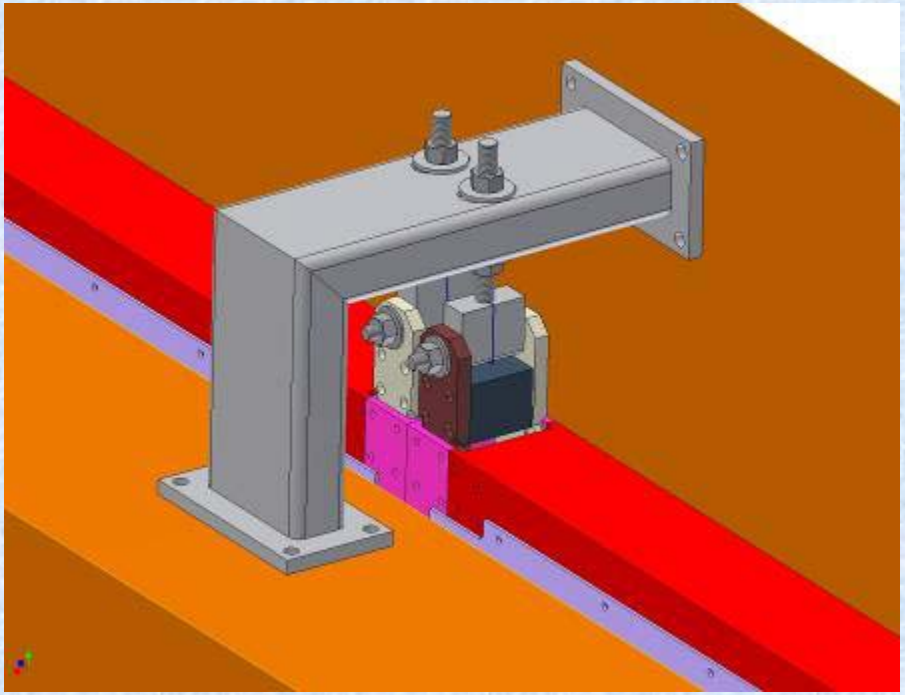
Bracket Eyes which partially interfered with HO7's are in similar locations on south as north : +/- 112" from CL (north is also +/- 112")



Crane support which interfered with HO8W is in siomilar location on north 5.75" from CL (Note: north dim is 7.0" Need to measure north clearances to be sure. Also need to measure height of interferences with survey prior to installation

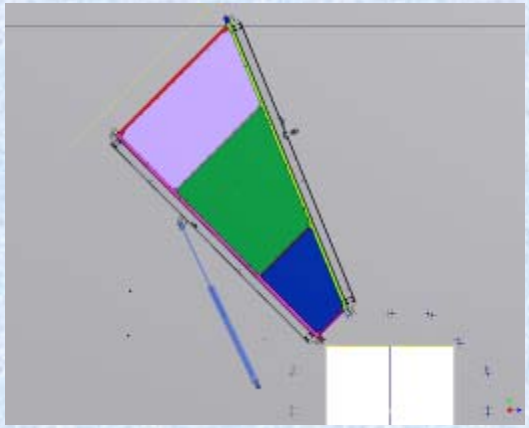
Upper supports for HO7 and HO8 (East & West)





RPC3 North

Installing HO8W & HO7W



HO7W
Installed

HO6W
Installed

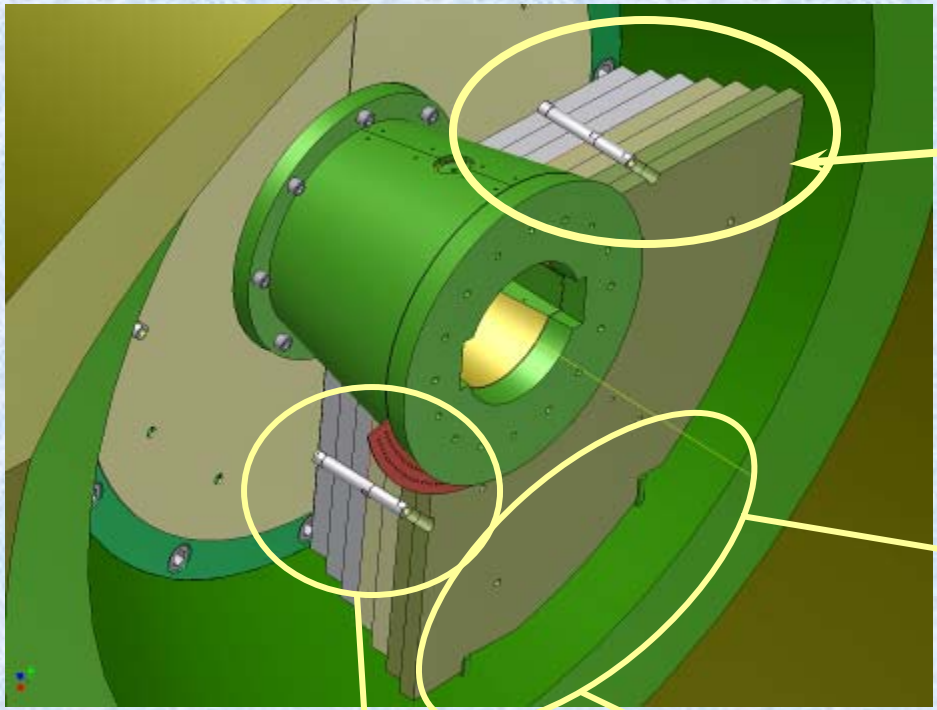
RPC3 North

Installing HO7E and HO5E

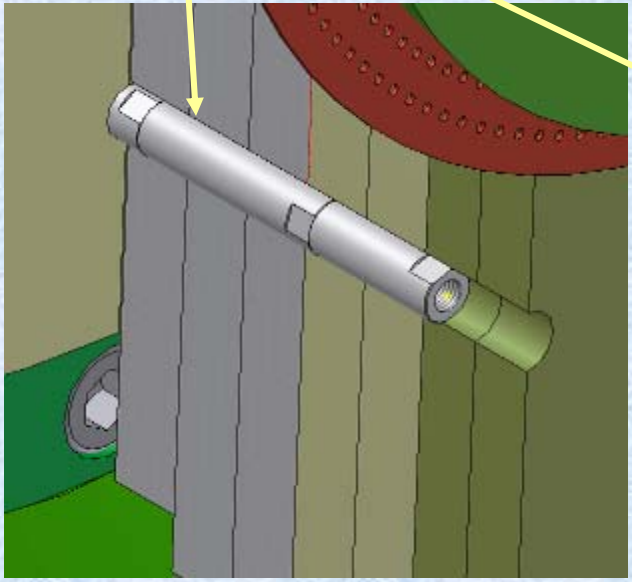
6. Absorber Installation

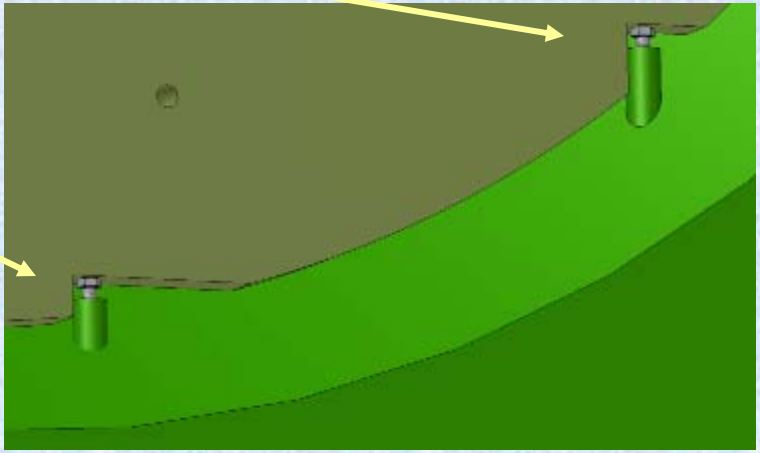
- Design
- Procurement
- Installation

Absorbers for both the North and the South side will be installed during the 2010 shutdown. The most opportune time will be while the Central Magnet is moved off the RHIC beam axis for installation of a new Beryllium beampipe, which has also been scheduled for the 2010 maintenance shutdown. Currently the absorber design and design of the absorber support structure has been completed and the components are in procurement. It is expected that the parts will arrive in time to be installed at the optimal time described above.



Absorber design concept:
7 layers, 4 quadrants per layer + 1 Shim layer Each layer indexed and bolted to previous layer. Installed 3 in assembled quadrant 2 or 3 layers using a counterbalanced lifting fixture.

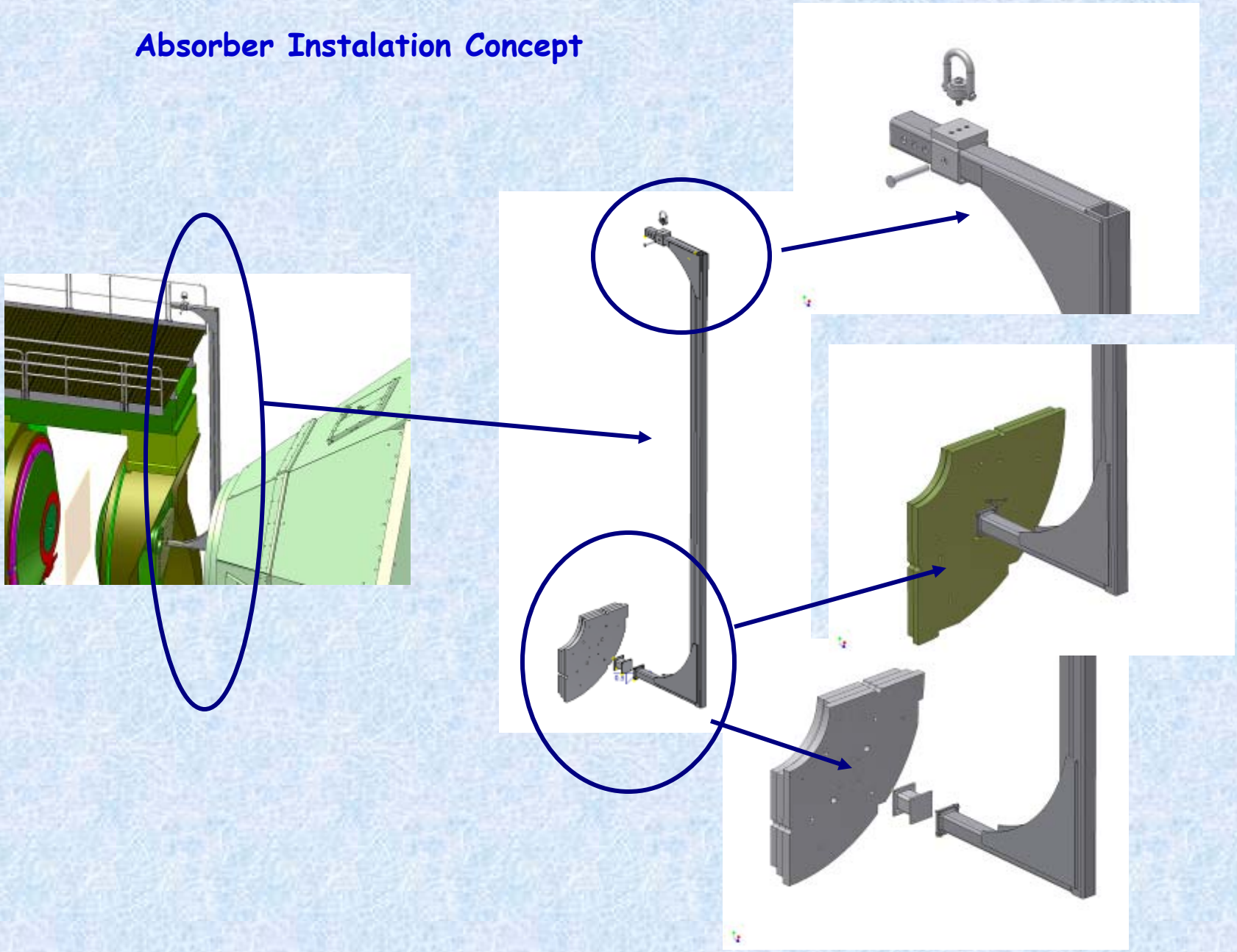


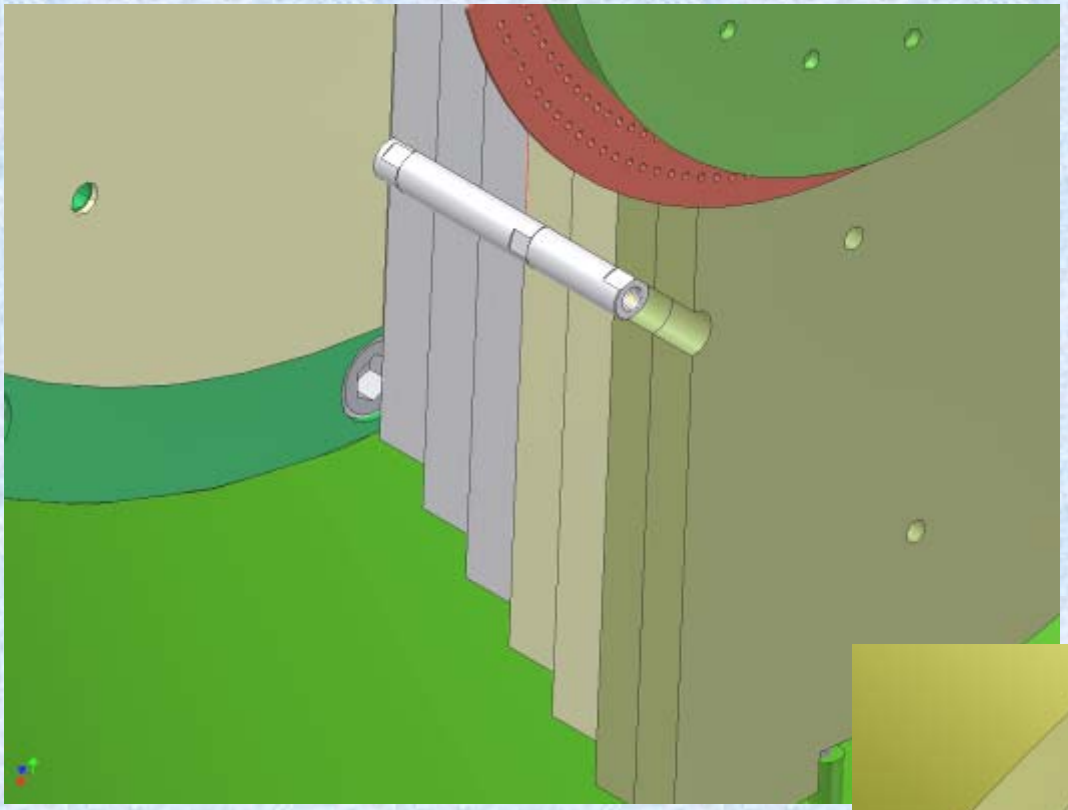


RPC Absorber Final Design

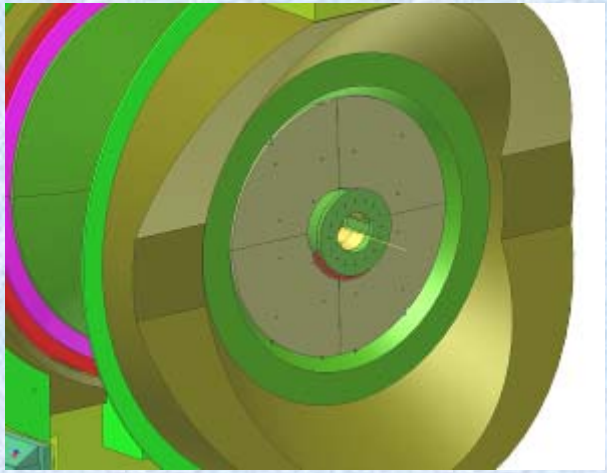
- **Welded & tapped vertical support bossess**
- **3 stage positioning rod**

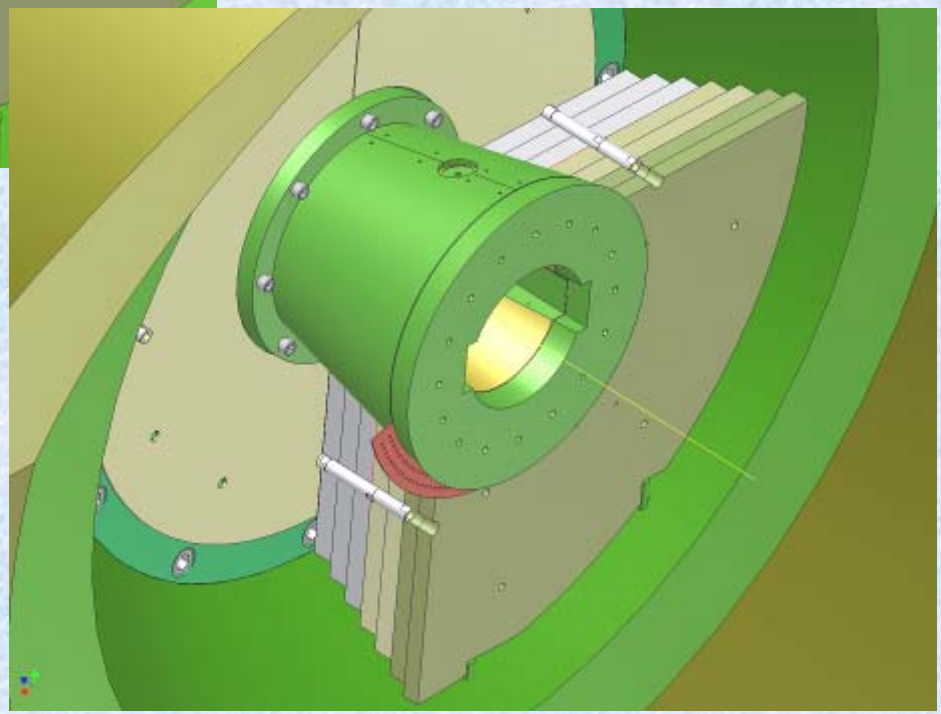
Absorber Instalation Concept



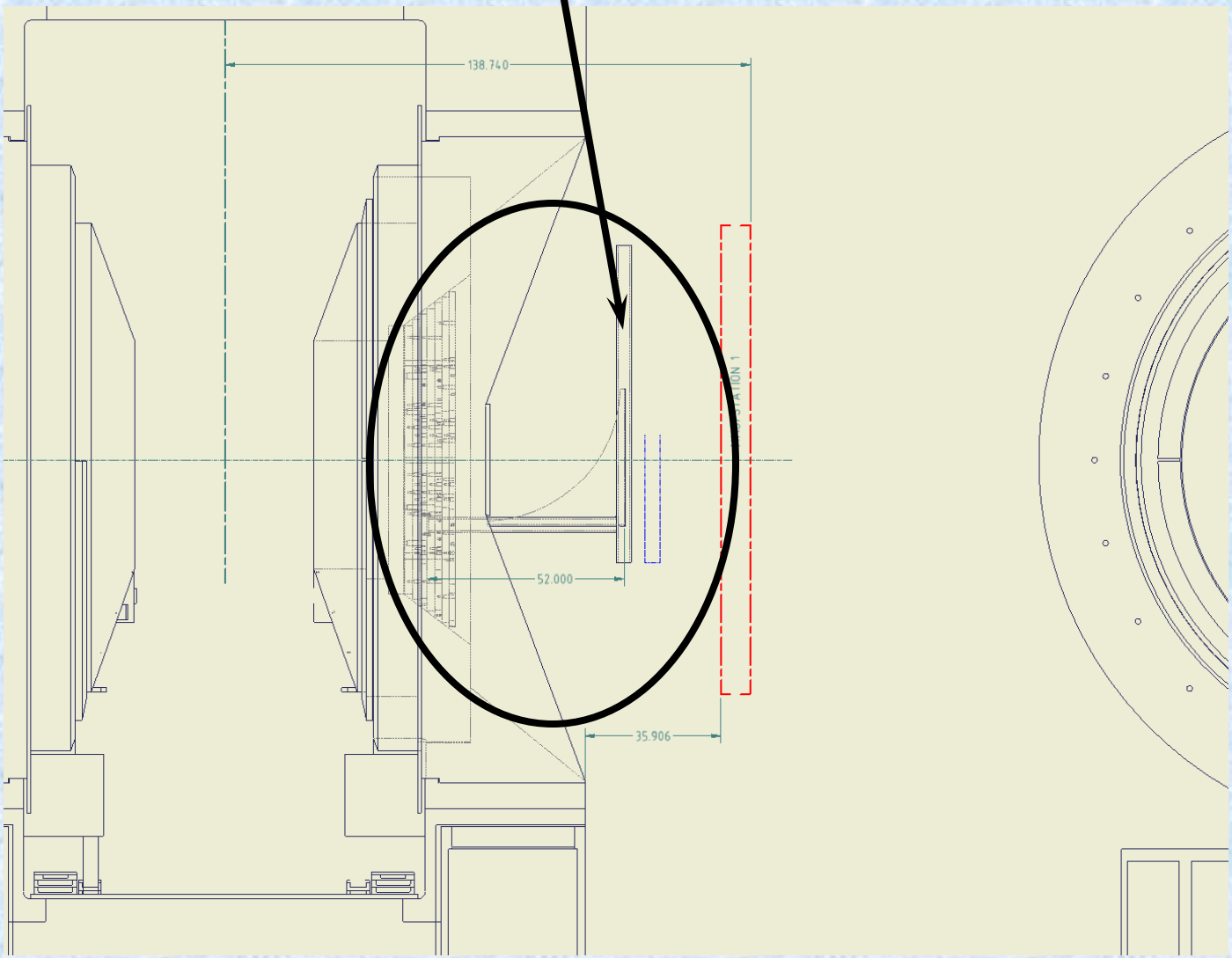


Absorber design concept: 7 layers, 4 quadrants per layer + 1 Shim layer Each layer indexed and bolted to previous layer. Installed 3 in assembled quadrant 2 or 3 layers using a counterbalanced lifting fixture.





Absorber Lifting Fixture: design in progress must be
Capable of installing when CM is on or off beamline



7. Electrical and gas services and environmental control:

- Install 1 new racks and re-work the existing prototype rack.
- Install new cable management system (cable trays) (similar to north)
- Install new rack components
- Re-store all removed/temporarily moved wiring and piping to operational routing
- Build new thermal/vapor barrier
- Install thermal control (heater, thermostat, air distribution)

Except for piping restoration, this effort is similar to the same tasks performed for the North. Re-storing piping includes cleaning and testing where appropriate. This is expected to be time consuming.

RPC3S Electronics Racks

Cable Trays

Thermal-Vapor Barrier

8. Site restoration:

- Restore shielding, access catwalks, F-cal, etc. to pre-installation configuration

Similar to analogous tasks for the North. Must be completed prior to end of shutdown.

Cat walks restored

Shielding restored

9. Installation closeout:

- Review all tasks undertaken for south installation
- Document difficulties and improvised procedures as necessary
- Identify necessary additional work necessary prior to commissioning
- Establish plans and schedule for RPC3 South necessary additional work
- Implement plans and schedule

This task recognizes that unplanned delays may result in some tasks being moved back past the end of shutdown. Addressing such tasks may require modifications in plans and procedures to fulfill these tasks during run 11.

Safety

- What Safety issues do we know of?
  - Material handling
  - Communication
  - Site hazards (Crane LOTO)
  - Work Coordination
  - Other
- What potential hazards may exist that we haven't identified
  - Legacy items
  - Access issues
  - Unplanned changes to work schedule
  - Manpower issues
  - Changes to conditions
- How do we deal with these
  - Stop, ask questions, re examine
  - Stop Work